AUGUST, 1957
Volume 11

FT food technology

THE JOURNAL OF THE INSTITUTE OF FOOD TECHNOLOGISTS

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THE TECHNICAL ARTICLES IN BRIEF

Fermentation *Cucumbers*

Influence of the plastic vat cover on the fermentation of cucumbers. Neil Finley and Melvin R. Johnston.

The use of plastic vat covers in cucumber fermentation as a method of contamination prevention was evaluated. Results obtained under the experimental conditions described give reason to believe that the application of vat covers will definitely improve the fermentation processes and the finished pickle products while decreasing filth contamination.

Freezing *Citrus Concentrates*

The time-temperature tolerance of frozen foods VII. Frozen concentrated orange juice. R. J. McColloch, R. G. Rice, Mary B. Bandurski, and Bruno Gentili.

Time-temperature-tolerance studies of 9 lots of heated and unheated commercial frozen orange concentrates revealed no difference in cloud and flavor stability after storage for 1 year at 0° F. as compared to storage for 1 year at −10° F. Studies of cloud and flavor changes in frozen concentrates throughout fluctuating time-temperature histories showed that in all lots cloud was less stable than flavor or ascorbic acid. But no 1 : 1 correspondence between cloud stability and pectinesterase content of the lots was demonstrated.

Commercial frozen orange concentrates (both heat-treated and untreated) varied widely in cloud and flavor stability. Flavor stability was greater in heat-treated lots as a group than in unheated lots as a group. In general, unheated lots retained 50% or more cloud after temperature abuses amounting to a cumulative exposure of 24 days at 10° F. during 1 year at 0° F. Heat-treated concentrates retained, in general, 50% or more cloud after a cumulative time-temperature history including one thawing to 20° F. or 40° F. in combination with a total exposure of approximately 24 days at 24° F. during the 1-year storage period.

Although flavor is quite stable in heated concentrates and relatively stable in unheated concentrates, effects of time-temperature histories on flavor are cumulative. It is indicated that ascorbic acid (vitamin C) was extremely stable throughout all time-temperature histories employed. Results indicate that changes in cloud and flavor of frozen concentrated orange juice may be initiated at all temperatures above 0° F.

Dehydration *Peaches*

Low moisture peaches prepared from fresh fruit. Ross S. Bean, Thomas H. Schultz, and Norma Jean Downes.

Seven lots of low-moisture freestone peaches, each representing a different supplementary treatment, were prepared from fresh fruit by drying *in vacuo*. Sulfite-dipped fruit packed in vacuum showed remarkable quality after storage for 6 months at 100° F. Though in-package desiccant (IPD) reduced the moisture content to less than half its initial level of 0.8% or less, its effects on quality were inconclusive. With higher initial moisture levels IPD would probably prove beneficial. Hunter color saturation values of the reconstituted fruit slices more nearly reflected panel color scores than did soluble color values expressed as colorimeter readings obtained at a single wave length. Limitations and possibilities of the 7 supplementary treatments and of 4 types of packaging used are discussed with regard to desirable future investigations.

Film packaging *Heat processed orange juice*

Film packaging of heat processed orange juice products. I. Some factors affecting stability of the product. H. C. Mannheim, A. I. Nelson, and M. P. Steinberg.

Effect of some processing conditions on the stability of heat processed orange juice was evaluated. Sorbic acid and sodium benzoate were found to be undesirable additives; sulfur dioxide was advantageous in preventing juice deterioration. Juice sterilization temperatures were determined by using pectic enzyme activity as an index. Temperatures found desirable were 210° F. for single strength juice, 220° F. for concentrated juice.

Effect of peel oil or pulp in processed juice was studied. Juice quality was determined by organoleptic examination, and the data were analyzed by analysis of variance. It was found that peel oil, naturally present in orange juice, did not cause flavor deterioration. Study of the effect of orange juice pulp on flavor deterioration pointed towards the advantages of filtering the juice.

Effect of light on juice during storage in transparent bags was investigated separately. Statistical analysis of the resulting data showed that light has no effect on orange juice quality.

Film packaging *Heat processed orange juice*

Film packaging of heat processed orange juice products. II. Storage study. H. C. Mannheim, A. I. Nelson, and M. P. Steinberg.

Suitability of flexible films as containers for heat processed orange juice and orange juice concentrate was investigated. Quality of orange juice products packaged in 4 different films was evaluated over a 20-week storage period. Storage temperature and addition of sulfur dioxide were variables. Canned juice products were the controls. Juice quality was determined by organoleptic examinations and several objective tests. Data were analyzed by analysis of variance. Addition of 200 p.p.m. sulfur dioxide to orange juice and storage at low temperature (36° F.) greatly retarded de-

August Cover. Technologists in the fisheries products branch of the food industry have had continuous success over the past several years in bringing new marine products of high quality to the consumer's table. The cover picture for August (courtesy of General Foods) shows one such product, fish sticks, undergoing quality control analysis in the laboratory.

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terioration. Juice packaged in Saran and aluminum-polyethylene pouches was acceptable after 5 months' storage. There was no difference in performance between these packages and cans, except that objectionable off-flavors were noticed in canned sulfited juice and in Saran-packaged juice when stored at elevated temperatures. In this study, Saran and aluminum-polyethylene poches were significantly better than Mylar-polyethylene and cellophane-polyethylene. Concentrated juice generally maintained better quality than single strength. Difference in weight loss between pouches was significant. Cellophane-polyethylene lost most weight followed in order by Mylar-polyethylene, Saran, and aluminum-polyethylene. It was concluded that it is feasible to package heat processed orange juice, or preferably orange juice concentrate, in pouches made from aluminum-polyethylene or Saran. Juice in these pouches should maintain a quality comparable to that in cans during storage for at least 5 months at 36° F. If 200 p.p.m. sulfur dioxide are added to juice packaged in aluminum-polyethylene or Saran it can be held at temperatures up to 74° F. for 5 months.

Inspection *Tomatoes*

Random vs. stratified sampling methods for tomato inspection. F. Filipello and S. R. Whipple.

Practically all foods are subject to some form of pure food law. To determine the defect characteristics, inspections are made by sampling of the lots. Sampling must be conducted in such a manner as to be representative of the whole lot. Fruits and vegetables are particularly heterogeneous in character throughout any one lot, and it is necessary to employ sampling methods based upon statistical theory in order to evaluate the lot. A standardized method for inspection of the percentage defects in tomatoes for use in canning is discussed. A comparison is made between a purposive random and stratified random design. Intervals of confidence for the true mean value of the defects are established from the data. It is suggested that each sampling procedure have an inherent day-by-day check test.

Curing *Sausage Products*

Action of phosphates in sausage products. II. Pilot plant studies of the effects of some phosphates on binding and color. C. E. Swift and Rex Ellis.

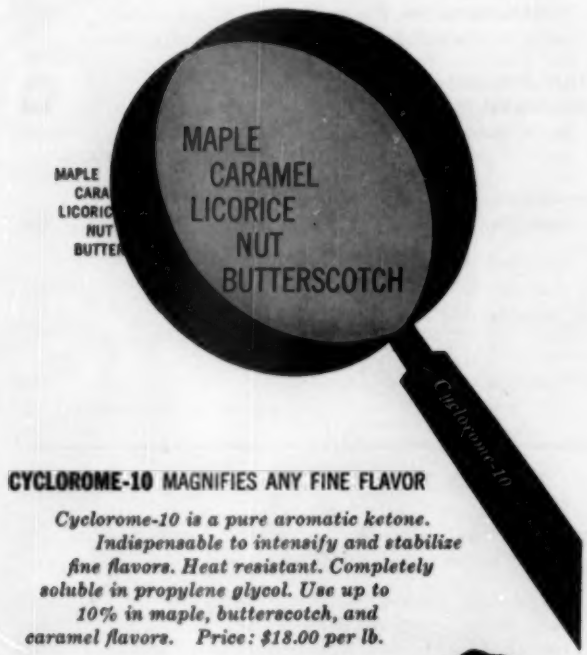
Effects of ordinary curing agents and of certain phosphates employed under varied conditions on the color and binding of frankfurters and bologna were studied. Shrinkage during smoking and cooking and cohesiveness as indicated by tensile strength measurements were employed as criteria of binding. The customary curing agents—sodium chloride, sodium nitrite, sodium nitrate, and sugar—applied singly showed that only the action of sodium chloride markedly enhanced heat development when emulsions were prepared, moisture retention during heat processing, and cohesion of meat. Three combinations of phosphates markedly increased the relative binding of sausage components. Relative shrinkage of bologna smoked and cured at temperatures used industrially was not affected by the 3 combinations. However, shrinkage of bologna heated to 160° F. was decreased by action of the 2 combinations of phosphates. Rates at which the temperature of emulsions increased during comminution was markedly reduced by certain of the phosphates tested.

Results indicated that the phosphates tested tended to inhibit color development in rapidly processed frankfurters, but not in normally processed frankfurters or in bologna heat-processed at either rapid or normal rates. Color developed on addition of one phosphate and one combination of phosphates to frankfurters was superior to that obtained with ordinary cure in products heat-processed at a normal rate. Results help explain previous contradictions as to the merits of phosphate-additives in sausage by showing that the action of the additives was affected by processing variables.

Antibiotics *Poultry Meat*

Antibiotics in poultry meat preservation: A comparison of the tetracyclines. Reese Vaughn, Charles W. Nagel, F. Miles Sawyer and George F. Stewart.

A comparison was made to determine the effectiveness of three tetracycline antibiotics for improving the storage life of chilled poultry. Six trials were made under commercial conditions. In 4 trials the birds were prepared as cut-up, tray packed fryers; in 2 trials the birds were packaged whole in polyethylene. All birds were stored at 7.2° C. (45° F.). Oxytetracycline treatment increased storage life in 3 of 6 trials, chlortetracycline in 5 trials and tetracycline in all 6 trials. Increases in storage life ranged from 0–3 days. Whole birds kept much better than those which had been cut up.



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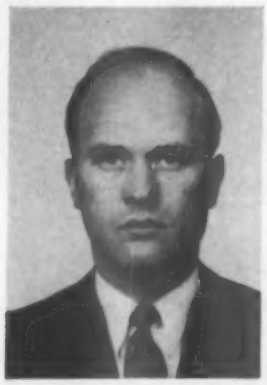
What Management in the Food Industry Expects from the Research Departments*

R. T. Foote

Executive Vice-President, Red Star Yeast Company, Milwaukee, Wisconsin

IT IS INDEED an honor for me to be with the Wisconsin Section IFT—at your birth, so to speak. I think it's indicative of the stature of the food industry in the state of Wisconsin that we now have a Wisconsin Section, and indicative of the fine work that's being done by Dr. Buck and Dr. Weckel here at the University.

I have often wondered what the layman thinks of research. It might be similar to the cartoon I saw in a recent issue of the *Post*. I always start with Hazel on the last page and thumb my way through the cartoons back toward the juiciest story. In following my usual routine recently I ran across a picture of a scientist in a white coat in a laboratory replete with glassware, rubber tubing, and smoking Erlenmeyer flasks and Bunsen burners, with kind of a harried look on his face, as the boss, in a dark suit and portly front, stood alongside him and said, "Jones, we've got to have a new product, *immediately*. The XYZ Company has just come out with their new Sudsy-Wudsies. We're in real trouble." Well, the rapid pace of industry today and of research might lead people to think that research is a push-button affair, that all we expect of our research department is to pop up with a new product every time we run into a little trouble with competition.



R. T. Foote, Red Star Yeast, Milwaukee

Allocation for research

The National Science Foundation estimated that industry spent $3,700,000,000 on research in 1953, and in a recent McGraw-Hill publication it was estimated that in 1955 these expenditures were up 20%. This same publication estimated that an additional increase of 33% in the next four years would occur. The food industry, by this same article, is estimated to spend approximately .2% of their sales dollar or 6.7% of their profits, after taxes, for research.

This ratio for the food industry is slightly lower than it is in some of the other industries. Aircraft, for instance, where the rate of obsolescence is high, is spending approximately 15% of their sales on research, or 69.9% of their profits. Chemicals and allied products are spending 2.2% of their sales. The pharmaceutical industry, as you know, is spending a high percentage of the sales dollar on research. The food industry, for various reasons, either because of the high dollar volume or because of the fact that many of our products are stable products which have been in existence a good many years, does not spend at quite so high a rate. However, we are spending dollars at a fantastic rate. The very evidence of that is the shortage of engineers and scientists that we all know about. And these dollars must be spent for a good purpose.

Research in the food industry is conducted in several ways. We have the individual companies who establish their own research departments and conduct research within their company organization. Many of the smaller companies have organized into associations in order to conduct their research, where their size does not justify the establishment of a department. Such organizations as The American Association of Dairy Scientists, the American Association of Cereal Chemists, The Research Institute of the Independent Cracker Manufacturers' Association, etc., are helpful in this type of research. We also have a lot of research done for our industry by our suppliers, and I'll just mention a few. The American Can Company and the Continental Can Company, I think, are known to all in the amount of work that they have done for us on our products. Crown Cork & Seal Company is another which has done a lot of work. Smaller companies sometimes establish a research department by hiring a food technologist, and putting him to work in a laboratory where he combines the control function and the research function, using published information, Government laboratories, and sometimes private research groups. We also have research institutions, non-profit groups such as the Battelle and Mellon Institutes. We have private research organizations—Arthur D. Little, Inc. comes to mind as one of the large, private profit research organizations. And then we have foundations that support research—the Nutrition Foundation is probably familiar to all of you.

Our discussion this evening is going to pertain to the research activities of the individual company. I

* Presented at Madison, Wisconsin, on the occasion of the Charter Day Session, the initial meeting of the Wisconsin Section, No. 27, March 29, 1957.

PROVERB PRATTLE

"Don't put the cart before the horse"

First found in Whittington's "Vulgarity" written in 1520: "That teacher setteth the cart before the horse that preferreth imitation before precepts." Shakespeare, in 1605, made use of the phrase in *King Lear* and again in *King Richard III*.

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will try to explain to you why I think such research is done. I could probably close this talk right at this moment, and we could all get back to the beer, by saying that we do research in order to increase our profits. I think it's as simple and straight-forward as that. But I don't think it would be fair to merely say that we want more profits. That's the very life blood of our American free enterprise system; it's much too obvious to say that we do research in order to increase our profits.

But before discussing what we expect our research department to do to increase our profits I'd like to give a few definitions, my own definitions, just so that in case some of these terms pop up later in the course of my address you'll know what I mean. Science has been described as a "pool of knowledge," and research as the instrument by which that "pool of knowledge" is enlarged. The definition of "research" that I like best, being a layman, is that research means "to look again," and bless the food technologist or any other scientist or researcher who does just that. For the undergraduates or any of the rest of you who would like a more erudite definition of research I have several. I'll only use one, and this was taken from an eminent scientist's definition: "Research is the application of human intelligence in a systematic manner to a problem whose solution is not readily available."

Three categories

Very briefly, there are three types of research—three broad categories—and while I agree with Dr. Conant that no definition ranging from fundamental or basic research to developmental work is possible, that you can't separate the various types of research, that it's a continuum that extends from one extreme to the other, I have chosen to throw research into three pigeonholes for convenience.

Fundamental or basic research. This is the type of research that I think was done in the very early days of science by the philosophers who gathered together in societies—scientific societies, natural history societies. They had no immediate goal in mind at all. They were just curious, just wanted to know why. Some fundamental research is done by industry today, but only the large industry is able to conduct what I define as basic or fundamental research. In the United States our universities are carrying the burden of all of our fundamental work. It would be true to state that in Europe it has been more traditional for them to do more of the basic type of research. I think the United States is becoming more aware of the fact that we must have this type of research in order to continue to grow and develop.

The kind of research with which industry is mainly concerned, I would divide into *applied* and *development.*

Applied research. To me, applied research means research that has no immediate commercial goal in mind, but is limited to a broad field with which the company's activities are concerned. For instance, we do work on the genetics of yeast. We study the nitrogen, the phosphate, the enzyme systems in yeast. We have no immediate commercial application for this work.

Developmental research. By far the most research that I feel is done by industry is developmental research, where we have an immediate commercial application in mind, where we take basic scientific truths, doctor them up, dress them up, package them, and try to sell them.

What management expects

So with these brief definitions, which are purely arbitrary on my part, I would like to try to explain to you what Management in the food industry expects of the research department. As I said before, we expect more profits, and you get more profits in many ways. The first is to increase sales. We can increase sales by improving old products. We improve old products to get greater consumer appeal. For example, after the orange-juice-squeezer day we had canned orange juice, and the next step was a frozen orange juice. We got a better flavor and better consumer appeal—the result of research. Ice cream was just as nutritious and just as good prior to the time that emulsifiers were used to improve and enhance the "mouth feel." Again, we were seeking better consumer appeal. Enameled cans were introduced in order to preserve fruit colors. The color of a product has nothing to do with the flavor or the nutritional value except as it's tied in with the other organoleptic reactions we have when we eat something. We like something that looks like a natural product. Again, consumer appeal. Clear wines, beers that have chill-proofing agents, are all examples of the research that's done in order to improve consumer appeal.

There is also research that's done in order to increase our sales, which may not have a direct bearing on consumer appeal but merely improves the quality of a product. Such things as the lower bacteriological counts in dairy products don't affect the flavor, the nutrition, or anything else. It's a quality improvement. I don't think there's a consumer who has drunk milk who realizes he's drinking fewer bacteria. Yet that's a product of our research departments. The greater retention of vitamins and other nutritional elements in our foods are examples of quality improvements, without changing consumer appeal.

Reducing costs for the customer

We increase sales by reducing our customer's cost; for example, in the customer's use of various products we constantly seek a yeast with greater fermentative activity so that our customers, the baking industry, buying a pound will get a greater amount of fermentation. We seek emulsifying agents that have a higher emulsifying activity. We have introduced liquid sugar, bulk flour. The housewife has benefited by our

research and has been able to reduce her cost in preparing food in the home by the introduction of prepared mixes. We have also developed better protective packaging so that we could reduce the customer's cost of distribution. We expect our research department, also, to improve the shelf life of our products; for example, the introduction of better coatings for candy to prevent blooming, the introduction of dehydration procedures. Active dry yeast is an example in our particular business. Concentrated freezing, canning—all are examples of the drive toward better and better shelf life.

There is another job that our research department has had to do, and that is to bring about better standardization of our products. For example, in the milling industry it's very important that the many bakers throughout the country get the same quality flour year in and year out so that their rather delicate process doesn't have to be changed with each new

The "proving ground" for research is the pilot laboratory.

crop. A very long and tedious research program in developing wheat varieties which will give uniform process characteristics in the flour has been conducted. The same thing has been true in the wine industry, where grape varieties have been developed in order to maintain the same flavor for a particular brand of wine year after year. Sometimes, I will admit, it has been necessary to compromise and we have to make a choice between greater shelf life or greater consumer appeal. And there it's up to the research department to present this problem to Management and let them make a decision, based upon the particular market situation.

We also try to increase our sales by modifying old products in order to find new uses in present markets, and also to find new markets for our present products. A quick example of this would be coated SAPP for refrigerated biscuits—the same product that had been used for years in baking powder—but now, in order to protect this product against a particular packaging problem, it is coated.

We, also—and this is something that everybody thinks of immediately—ask our research department to develop new products for us. What kinds of new products? These products have to be designed to meet some of the following requirements: the amount of capital that the company is prepared to put into a new product; the annual sales volume potential in a new product before putting it on the market; a new product to use available production capacity; or a product to round out the present line so that the sales department and distribution facilities are used to the fullest. New products that utilize by-products are familiar to all. Another important segment of importance in new products would be that which develops a product to mesh in which commodity purchases. For instance, in our industry, we buy large quantities of molasses on a commodity market. Our ability to buy large quantities determines the price we have to pay for molasses; thus, besides using the molasses as a basic raw material for yeast, if we can develop new outlets for molasses we can also put ourselves in a better position to make a good purchase. Another very important consideration in the development of now products is that these products mesh into the talents that are collected in the research department.

Another way of increasing profits, naturally, is to reduce costs. Here again, I think the research department can play a very important role. They can anticipate and prevent trouble; they can cure existing troubles and nuisances. They can increase yields; they can reduce processing losses, and they can develop processes that will reduce the cost of raw materials. Labor-saving devices should be a constant goal of the research department. They can reduce maintenance costs. Corrosion control in the food industry, as you all know, is a very important feature of our costs. I believe that the research department is primarily responsible for constantly seeking better materials for handling our processes. A very important consideration in reducing costs is to reduce the initial capital investment for production. Many of our industries require a very high initial capital expense per annual dollar of sales, and the research department can make a very great contribution to "profitability" by reducing the cost of increasing capacity.

The technical information backlog

In addition to these very practical considerations I think that it is highly important that the research department amass technical information for future use. "Defensive" research is well-known to all of us—where research is necessary even though without any immediate practical importance. We must conduct a research program to protect present products and to protect our competitive position in the market. The amassing of technical information is of great importance to the internal operations of the research laboratory. Many a "lost cause" that has lain quietly in a file drawer for many years has popped up two or three years later and, coupled with more recent knowledge, become a very important contribution to research. The research department must also amass technical information and keep track of technological

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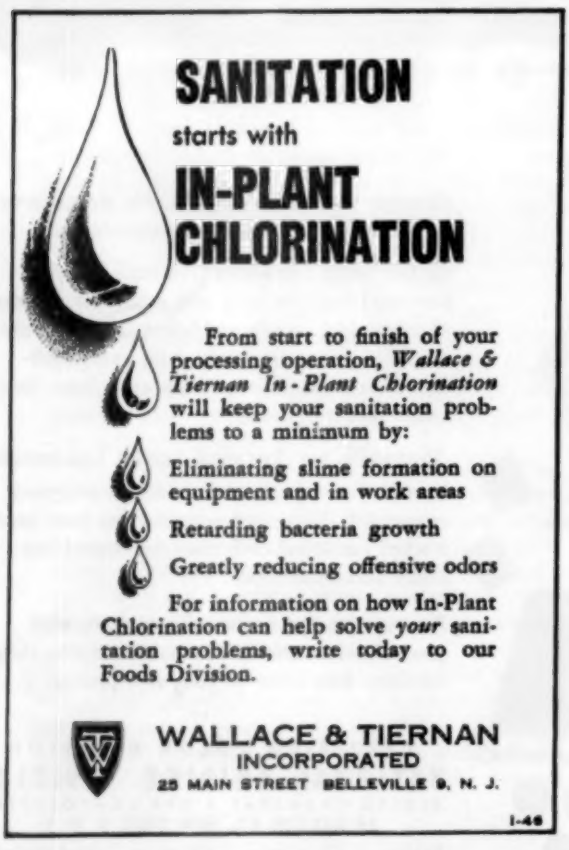
improvements within its industry in order to keep its management informed of progress. And lastly, but not leastly, I feel that the research department's principal responsibility is to sell its own importance to top management.

Men are the most important feature of our research departments. In order to constantly direct attention to and guide the activities of our research departments and in order to accomplish the things that I have just mentioned, I feel it's important for the research department to maintain balanced relationships with production and quality control, with sales and advertising, to find out what their problems are, with the financial department and the cost control department, and, as I have said, with the top management of the company to help them guide the fuature. A well-rounded organization is necessary in order to accomplish this. In our company we charge three men with the responsibility of guiding the activities of our research department. We have a Director, whose principal responsibility is contact with the sales department, top management, and outside contacts. We have a Manager of Research, whose responsibility is the internal functioning of the laboratories—the meshing of the various laboratories so that they can present a united front on any project. And we have a Coordinator of Technical Operations, who is a liaison force effecting affinities between research and production.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The research department must maintain several service departments, a library, cost control department, secretarial service for its scientists, a statistical department, a purchasing department, repairs and maintenance, a facility for presenting our data in forms and reports, a patent department, a law department to watch new developments from the Government and the Food and Drug Administration.

The laboratory organizations can be set up on a functional or a project basis, depending upon the requirements of individual companies. We must also maintain an adequate balance of applied and development programs. I think it's necessary for the Director and the Manager to constantly watch their budget, and balance the amount of applied work (so that they have the information they will need in the future) with their development work. They must also maintain trouble-shooters for sales and production; and we use, in our company, senior scientists—men who are assigned a particular project, but also who provide a scientific panel or a scientific board for our various laboratory directors, project leaders, and the heads of our research group.

We expect the research department to maintain adequate outside technical contact with our customers, suppliers, trade groups, government groups (in order to keep track of regulations), and universities. We maintain fellowships in universities in order to provide recruits for our laboratory for the future, in order to keep in contact with the university and in touch with the people in the university. We have a program that provides employment for university people during the summer, so that they, in turn, can find out what we in industry are seeking from our research department, in order to crossbreed and cross-exchange information. There are various technical societies, of course, and we maintain a group of consultants that bring in outside information, outside ideas. Then there are various research groups and a strategic group that keeps an eye on competition at all times.

Formula for cost-analyzing research

As I said before, the principal reason for having a research department is to increase profit. I am a firm believer that research must pay its own way. Otherwise, it doesn't belong in industry, and if we don't have a research department that does pay its way let's close it up and let these engineers and scientists go out where industry so badly needs them. There are many arbitrary means by which we can measure the profitability of our research department. I would like to suggest that they be measured in terms of dollars, and suggest one very simple, if rather arbitrary, formula. We credit our research department with 3% of new sales dollars for a two-year period. We credit them with two years of cost reductions, and we credit them with a capital cost reduction. Based upon this arbitrary formula, I would state that a fair return on our research department would be 40% on our investment. I would also recommend that if any

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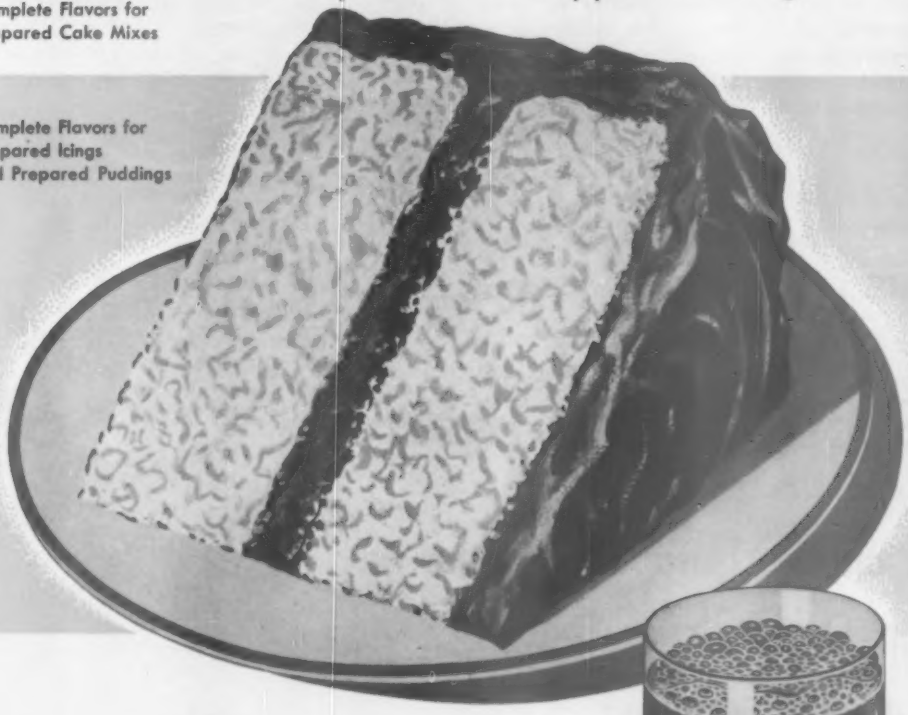

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of you want to use that formula for measuring the productivity of your research group that you insist upon a running 5-year average, because it isn't possible always to maintain development programs that are coming up with profitable items while you are still amassing information for the future through your applied research.

We expect a lot from our personnel in the research department. But we do not amaze ourselves, nor do we amaze them by these high expectations. I believe there is sufficient blue sky in research to warrant hanging our goals on a star. If I were to be forced to choose the most important function of the research department I think I would say that their first duty is to sell research to top management. After we have convinced ourselves of the importance of having a research department the relative importance of the main expectations enumerated earlier will depend upon the requirements of each of our individual businesses. The research department must keep itself attuned to the many problems associated with the business complex, putting stress on cost reduction, new products, raw material utilization, etc., as business conditions dictate. In essence, then, we expect our research department to be the watch dog of safety of our present profit margin, the lifeguard who jumps in in an emergency to save production or rescue a customer, the doctor who analyzes our health and is prepared with short- or long-range cures, and the oracle who must gaze into the future and prepare today that which we will need in years to come. As W. C. Stolk, President of American Can Company, has so aptly put it, "Those who do not adequately plan obsolescence through research may well become victims of obsolescence." God bless any of you who are thinking of joining a research department or who are presently in a research department. We need all of you.

Of Professional Interest

Report on the Third Symposium on "Foreign Chemicals in Foods"

Como, Italy—May 14-18, 1957

BERNARD L. OSER

Food Research Laboratories, Inc.,
Long Island City, N. Y.

THIS SYMPOSIUM was the third in a series of five sponsored jointly by the International Commission of the Agricultural Industries (Commission Industries des Agricoles) and the Permanent International Bureau of Analytical Chemistry (Bureau International Permanent de Chimie Analytique). The Secretary-General of the former organization is Professor C. R. Shabetai. The President-General of the Symposia is the venerable French chemist Professor Dr. Gabriel Bertrand.

The first of these Symposia was held in 1955 in Vienna, the second in July 1956 in Amsterdam—the proceedings of which have since been published. The recent one was attended by about 270 scientists and administrative officials; 143 from Italy, 39 from France, and the remainder from 17 other countries. Three persons came from the United States, Dr. Francis A. Gunther, University of California, Riverside, California, Dr. Lloyd W. Hazelton, Hazelton Laboratories, Falls Church, Virginia, and the writer.

PROGRAM

The first day of the Symposium was devoted to meetings of various Sub-Commissions, viz., the Sub-Commission on Antiseptics under the chairmanship of Professor S. W. Souci, Director of the German Institute for Research on Food Chemistry, Munich; the Sub-Commission on Antibiotics under the chairman-

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ship of Mr. A. L. Bacharach, now a private consultant but formerly associated with Glaxo Laboratories, London, England; the Sub-Commission on Coloring Matter under the chairmanship of Professor R. Truhaut of the Toxicological Laboratories, Faculty of Pharmacy, Paris; and the Sub-Commission on Toxicological Testing also under the chairmanship of Professor Truhaut. (The writer is a member of the Sub-Commission on Antibiotics.)

The second day was devoted to the formal opening of the Symposium, addresses of welcome being made by various Italian host members of the Conference as well as by officials of the sponsoring organizations. In addition several addresses were delivered on the subject of the effects on nutrition of farm animals of the "biological catalysts"; the employment of pesticides, herbicides, and germicides and on toxicological problems arising therefrom. These discussions and addresses were continued into the third day of the Conference. Among the participants were Professors C. Foa and A. D'Ambrosio of Milan, Professor F. Reith of Utrecht, Professor R. Klimmer of Bonn, Professor E. Bottinni of Turin, Madame van den Bruel-Dormal of Belgium, Professor M. E. Alessandrini of Rome, Dr. F. A. Gunther of California, and Professor R. Truhaut of Paris.

The general tenor of these addresses was to emphasize the need for effective regulation in the interest of protecting the consumer not only against toxicological hazards resulting from pesticidal residues but from possible dietary deficiencies due to effects of additives on nutrients. It was suggested (Foa) that while it is right to forbid adulteration of food it is unwise to denounce dangers that exist only in theory. Recommendations were advanced for various international and intranational approaches to the regulatory aspects of foreign substances including the promulgation of lists of approved additives, the establishment of a Codex Alimentarius Europeensis, the specification of toxicological testing procedures and "permissible maxima" or safety limits, and the regulation of label declarations of ingredients added to foods.

Difficulties of international regulation. One of the difficulties of international regulation was illustrated by Professor Reith's estimates of the possible consumption of arsenic, lead, copper, mercury, and fluorine resulting from their presence at specified tolerance levels, based on the assumption of a daily intake of 200 g. of fruits and vegetables. Professor Schweigert contended that South Africans might eat as much as 10 times this quantity. In a similar vein it was later pointed out that stilbestrol implantation in the necks of chickens posed a special risk to Austrian peasants who make a soup from chicken heads.

On this subject of regulation Dr. A. G. P. van Veen, representing the Food and Agriculture Organization, stressed the futility of attempting to adopt international legislation in an area affected by divergent viewpoints within countries, as well as between them, and by differences in national dietary and technological requirements. He pointed out, however, that cooperation, rather than legislation, is possible at the international level even though the results are slow, and that meetings such as this tended to promote a more rational approach to the subject. He pointed to the activity of FAO in publishing regular reports of "Current Food Additives Legislation" and said a similar release might be undertaken in the field of pesticides legislation.

The conservative viewpoint of certain German scientists was manifest in the proposal of Professor Klimmer (Bonn) that no residues of pesticides, however safe, be permitted in basic foods (i.e., the major sources of calories and vitamins in any particular country), and tolerance limits be established for the use of all other pesticides except certain "dangerous" ones which should be abolished altogether. He was questioned on where to draw the line as to basic vs. non-basic foods, and dangerous vs. non-dangerous pesticides.

Several papers, notably those by Mme. Dormal and Dr. Gunther, were directed toward the technical aspects of residue analylsis, including the distribution and degradation of pesticides on and in plant tissue, and the time relationships between application on crops and the distribution of produce for consumption. Emphasis was placed on the necessity of pesticides in agricultural production, hence for establishing realistic tolerances. Modern techniques of residue analysis require elaborate and expensive equipment as well as the organized support of the agricultural industries. Reference to diphenyl (used on orange wrappers) as a coal-tar derivative and thus a source of possible carcinogens was described as "witchcraft." Similar allusions were made by Professor Bruecke (Vienna) to the attacks on the fumigant methyl bromide, capable of binding sulfide (HS) groups but without adverse residual effect under conditions of practical usage.

Discussions continued on the third day on the subject of international control. M. Souverain, a French regulatory official, proposed not only the promulgation of lists of permitted additives but the establishment of international certificates of conformance for trade in major food items. These would be based on specifications governing the identity, labeling, and conditions of use (and removal) of permitted pesticides.

Several reports were presented from the viewpoint of the agronomist on the use of artificial maturing agents, growth inhibitors, and chemical fertilizers in agricultural production. Some question was raised as to the desirability of using such agents even though their functional values were generally admitted. The wiser course, it was said, is to use manures of various compositions as fertilizers, to use genetic methods for the improvement of food crops, to use surgical ("natural") castration rather than estrogenic hormones, until more is known of the latent effects of chemical treatments. Nevertheless it seemed to be agreed that when "properly" used such chemical substances present no foreseeable possibility of impairing the hygienic value of foods.

Aluminum Foil Packaging–
Resistance to Insect Infestation

Report No. 10 of a Series by Reynolds Metals Company

Insect infestation of packaged foods and other products is important from the standpoint of health and sanitation as well as economics. And products, even though free of insects when packaged, may become infested by insects penetrating the package material itself.

Food manufacturers and processors are vitally concerned with the insect resistance of packaging materials. Consumers, too, have a stake in this—and so do wholesalers and market operators who can boost profits by purchasing in larger quantities. The risk is big, however, because of the difficulty and expense of insect control. Regardless of storage care, packaged foods pass through so many channels that contact with a wide variety of insects is inevitable.

The ability of insects to penetrate packages varies. It depends on the species of insect and its stage in life, the presence of folds, creases or scratches on the outside surface of the package, and particularly upon the type and thickness of the packaging material.

Among all materials, aluminum foil is outstanding in its ability to resist penetration by insects. This is in addition to its well known superiority in maintaining freshness and flavor by excluding moisture, air, odors and light.

Aluminum foil has several properties that make it an excellent insect barrier. It is hard, making it difficult for most species to bore through. It is odorless, tasteless and has no food value to attract insects. It is opaque and insects appear to prefer transparent materials. Since hunger or the desire for seclusion is the driving force that causes insects to bore through packaging materials, they are selective in their attacks. Most plastic and organic packaging materials absorb or allow the escape of food odors that insects can detect. In many instances, these materials themselves have characteristic odors or tastes that attract insects. Aluminum foil is non-absorptive and practically impermeable, making it an ideal component for insect-resistant packages.

Studies with various insects, particularly the cadelle and the lesser grain borer (both extremely good borers), have shown that they will penetrate 80% to 85% of packages made from widely used plastic films within two or three weeks' time. Proper use of 0.001" aluminum foil cuts this penetration to zero over a one month test period.

Greatest attention to this insect problem is being given to consumer packages—generally sealed overwraps, carton liners or pouches. But bulk storage of products for future use or processing presents an even greater problem. The solution is provided by the large variety of aluminum foil materials and packages available for bulk storage. These include multiwall bags with aluminum foil liners, case liners of aluminum foil, foil-lined fiber drums, and aluminum foil for lining storage bins. Use of aluminum foil for lining storage bins also permits effective fumigation to prevent reinfestation without contaminating the products stored.

The accompanying table gives the results of a controlled one-year test of insect infestation in a bulk storage situation.

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One Year

CONTAINERS TESTED
Unlined Hogsheads and Hogsheads lined with laminated aluminum foil material (.0015" heat-sealing plastic film .001" aluminum foil 80-lb. paper)

RESULTS OF TEST

UNLINED HOGSHEADS
All were infested to a depth of 10 to 11 inches. Resulting tobacco loss was as high as 6%.

LINED HOGSHEADS
Infestation was confined to two small surface areas where lining material had been punctured. Penetration zero. Loss zero.

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See "Circus Boy", Sundays, NBC-TV. Watch for Reynolds on "Disneyland", ABC-TV Network.

REPORTS OF SUB-COMMISSIONS

Reports of Sub-Commissions were presented on the fourth day of the Symposium. Mr. A. L. Bacharach, in behalf of the Sub-Commission on Antibiotics, stated that careful consideration has been given to the preliminary draft of a report, to be submitted to the next Symposium, which will consider the problem from four aspects:

1. The presence in human food of antibiotic residues resulting from the oral administration of antibiotics in feeding stuffs, whether this has primarily a nutritional, prophylactic, or therapeutic objective.
2. Antibiotic residues in fresh foods resulting from direct, pre-slaughter, clinical administration by whatever route, other than as a constituent of the animals' food.
3. Recent studies of antibiotics as pesticidal agents in agriculture and horticulture seem certain to lead to commercial applications which will necessitate considering the amounts and effects of resultant residues in crops harvested for direct human consumption.
4. The use of antibiotics as preservatives and therefore their presence in foods as additives rather than as residues, will be considered under several sub-heads, principally for meat, poultry, and fish but also for canned and raw vegetable products and in the whaling industry.

A preliminary report of the Sub-Commission on Flavorings and Condiments was presented in absentia by Dr. M. H. Jacobs (USA). Recognizing the unreasonableness of a blanket prohibition of such additives on the ground that some may be toxic, a 3-point procedure for evaluating the problem of the safe use of flavors was proposed. This involves (1) collecting of data concerning toxicity and conditions of use, (2) establishing lists of relative toxicity of flavoring materials of varying degrees of importance, and (3) considering the status of pertinent regulations. The Sub-Commission recommended classification of flavoring materials as those considered suitable for use, those on which toxicity data should be gathered immediately, those on which such data should be reviewed or are desirable, and those which present data indicate should be banned.

Use of estrogenic hormones. Use of estrogenic hormones in poultry and livestock was thoroughly debated on the fifth day. The advantages of diethylstilbestrol implantation in poultry were generally (but not unanimously) recognized. It was declared however that the interests of the consumer were paramount to those of the producer and hence the uncontrolled use of such hormones should not be permitted. The practical effects of estrogens in cattle, sheep, and swine were considered to be dubious or at least variable. Professor Bruecke opposed the prohibition, on purely theoretical grounds, of worthwhile additives, including estrogens, pointing out that pregnant cow meat may contain as much as 50 mg. of estrogen per kg. Nevertheless he stated one could not condone the administration of "definitely bad" things such as the implantation of estrogen crystals, which might result in the presence of added estrogens in human food, citing, as examples, the presence of estradiols in the fat of stilbestrol-fed hogs or in chicken head soup, a food eaten by Austrian farmers. He urged a moderate attitude and the exclusion of irresponsible experimentation.

Professor P. Ubbels (Netherlands) referred to the U. S. Symposium on Medicated Feeds and joined Professor Bruecke in support of the idea of an international commission of experts to assess the problem of hormones in feeds. Professor Truhaut, in commenting on Professor Bruecke's remarks, agreed that the use of additives should not be permitted unless their chemical and biological properties were known but insisted that experimental evidence must also show a high probability of non-harmfulness.

Additional contributions. Professor C. Antoniani (Milan) discussed the relation between vitamins and enzymes from the viewpoint of the possible addition of the latter to foods. He concluded that more research is needed before any positive recommendations can be made.

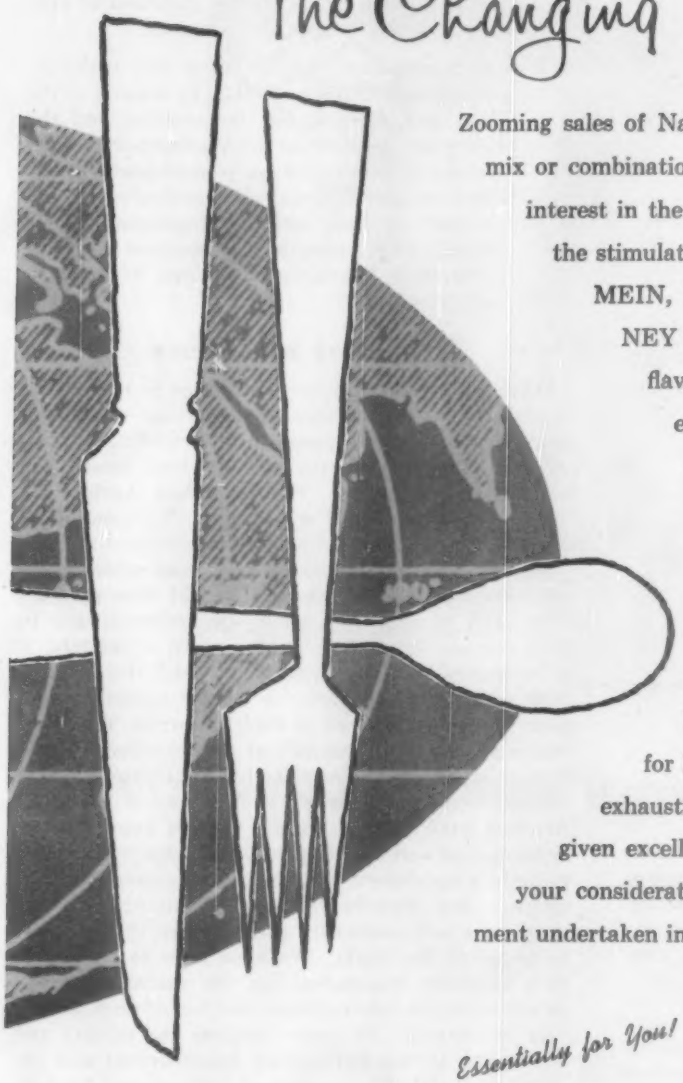
A presentation was made by M. G. P. deFeral (Paris) on the subject of label declaration of additives to foods. The guiding principles were said to be (1) to insure honesty in commercial transactions and (2) to inform the consumer of the presence of ingredients which he might wish to avoid. A long, vigorous debate ensued in which most discussants supported the first, rather than the second, objective. It was brought out that the declaration of ingredients had only limited value from the public health standpoint because many foods are not offered in packaged form, because foods containing additives in safe amounts would be avoided by those who fear or are confused by incomprehensible chemical names, and because of the inequity of requiring the declaration of additives but not of the same compounds when present naturally. However, the meeting could not agree to a resolution on this subject and M. G. d'Eaubonne, a spokesman for industry, who argued against labeling of foods as though they were drugs, regretted the inability to reconcile the scientific, government, and industrial views and urged continued efforts to seek rapprochement.

Dr. Truhaut speaking in behalf of the Sub-Commission on Colors took cognizance of the views expressed at the 1956 meeting in Rome of the International Union Against Cancer regarding the risks of carcinogenesis, and of a meeting in Ascona, Switzerland in April 1957 at which the following list of colors considered acceptable for food use was developed:

NATIONAL SPECIALTIES RATE HIGH

IN

"The Changing World of Food"



Zooming sales of National Specialties in canned, frozen and dry mix or combination form indicate a vastly increased American interest in the culinary delights of other peoples. They like the stimulating and distinctive flavors of PIZZA, CHOW MEIN, BLINTZES, BORSCHT, CURRY, CHUTNEY and ENCHILADAS . . . but here indeed the flavor must be right! If it isn't, despite the lure of exotic names and places, Mrs. Housewife will not buy a second time. The general popularity of National Specialties can often obtain your first sale . . . the second and all thereafter can only be insured by a quality product that lives up to the family's highest taste expectations. The D&O Flavor Laboratories have developed an entire group of Seasonings for National Specialties, for just this purpose. In exhaustive tests with the finished products they have given excellent results. Trail quantities will be sent for your consideration on request . . . and individual development undertaken in the labs on specific problems. Consult D&O.

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LIST OF FOOD COLORS IN CLASS II*

Presented at the Third Symposium on Foreign Chemicals in Foods
Como, Italy, May 14-18, 1957

	Schults	Color Index	Hecht
Red			
1. Ponceau 4R	213	185	41
2. Scarlet GN	.....	.....	34
3. Azo rubine	208	179	38
4. Amaranth (FD&C Red. No. 2)	212	184	40
5. Fast Red E	210	182	39
6. Ponceau 6R	215	186	42
7. Cochineal	1381	.....	107
8. Orseille	1386	1242	....
9. Erythrosine (FD&C Red No. 3)**	887	773	93
10. Anthocyanins	1394	.....	112
Orange			
1. Sunset Yellow FCF	.....	.....	29
2. Orange GGN	.....	.....	32
3. Bixin (Annato)	1387	1241	109
Yellow			
1. Tartrazine (FD&C Yellow No. 5)	737	640	64
2. Fast Yellow	172	16	23
3. Quinoline Yellow	918	801	97
4. Resorcine Yellow	186	148	26
5. Turmeric (curcuma)			
Green			
1. Chlorophyll-copper complexes	1403	1249a	110
Blue			
1. Indigotine (FD&C Blue No. 2)	1309	1180	105
2. Indanthrene Blue RS	1228	1106	104
Black			
1. Brilliant Black BN	6	6	58

* Carotene and riboflavin were not listed but are considered acceptable.
** Not recommended in candies or other foods used by children.

RESOLUTION

At the conclusion of the Symposium a special committee, acting in behalf of the assembled group, presented the following resolution:

The Symposium, considering the modern techniques of animal breeding that require the use of growth-promoting substances in the production of foods destined for human consumption, expressed the view that the following four conditions apply to their employment:

I. In the first place and fundamentally, harmlessness for human health of products derived from animals which have ingested these substances; proof of their efficacy in zootechnology; the absence of unfavorable effects on hygienic, nutritional, and technological properties; the possibility of control.

II. The Symposium considers that in the actual state of our knowledge there is no reason to think that the rational utilization of chemical fertilizers exercises an unfavorable influence on the hygienic and nutritional quality of plant products designed for man or animals.

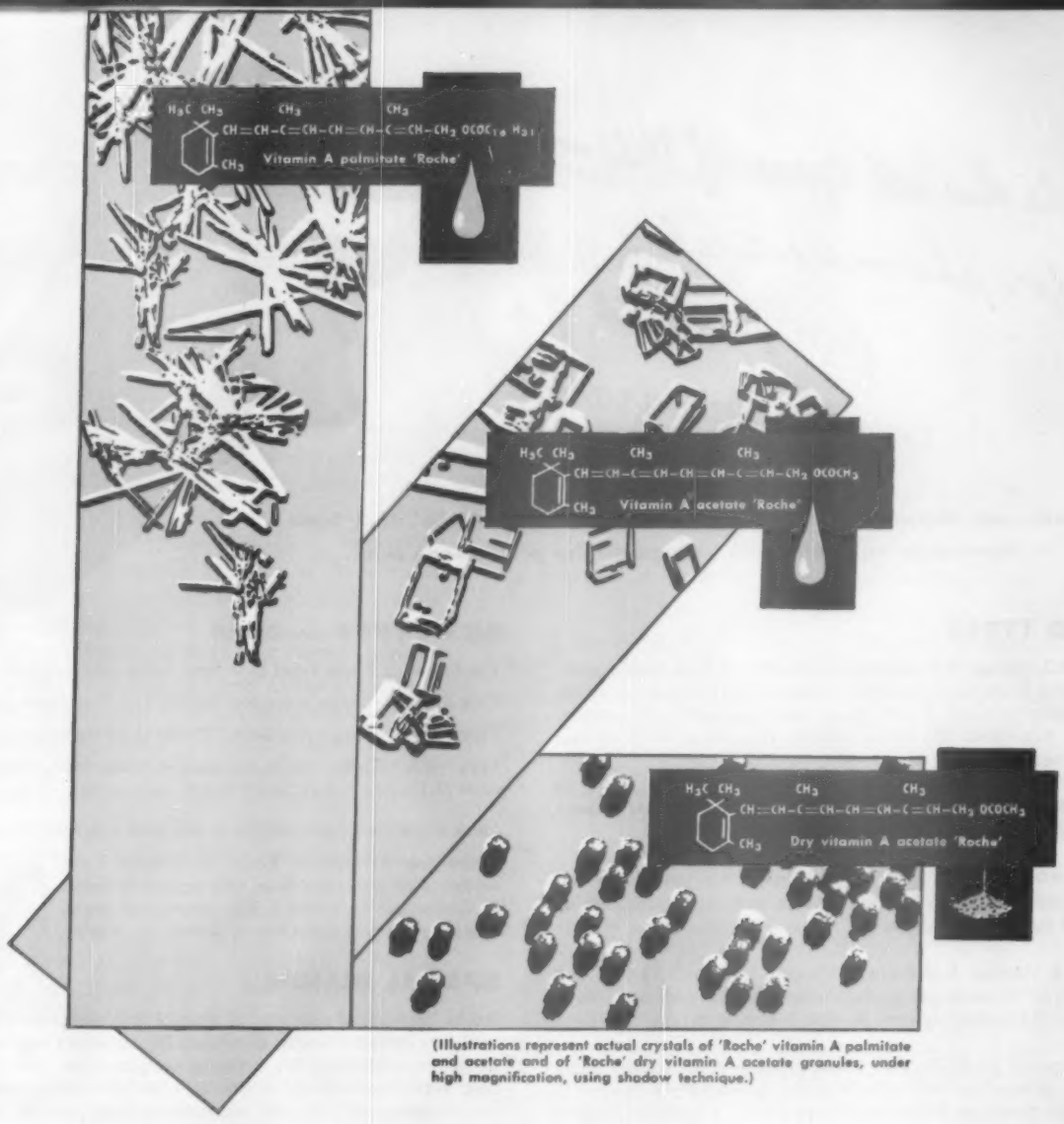
III. The Symposium, considering the emotions aroused in certain countries by campaigns of denigration against modern techniques of agricultural and food production, expresses the wish that greater publicity be given to these efforts in various countries and that competent bodies be invited to participate in order that public opinion be accurately informed of reliable scientific results and opinions.

IV. The Symposium, acting upon the wish expressed at Goettingen in 1955 by experts of the Food and Agriculture Organization and the European Federation of Zootechnology concerning animal nutrition, reemphasizes the urgency of international standardization of analytical methods and of legislation, work already undertaken in collaboration with the Permanent International Bureau of Analytical Chemistry.

BY WAY OF EVALUATION

While questions have been raised as to the official international status of the organizations sponsoring these Symposia, they appear to be providing a valuable medium for the exchange of views among the participating countries. The Food and Agriculture Organization and the World Health Organization of the United Nations, and the International Union of Pure and Applied Chemistry have unquestioned official standing. However the activities of these agencies often lead to questions which are referred back to their respective member countries and, ultimately, it is individuals such as those who attend this Symposium who are called upon to render opinions or to make decisions in behalf of their countries. Thus continued attendance, if not official participation in these Symposia, would appear to be highly desirable.

In the writer's view we in the United States of America have a much broader base of experimental, technological and toxicological knowledge upon which to build a regulatory philosophy concerning food additives. Our capacity for enforcement of food and drug laws is considerably greater than that of most countries of the world. We have more to contribute to a scientific foundation for the principles which should underlie international control—if such should ever be adopted. In many respects the reports and discussions at this Symposium demonstrated how the emergence and development of policies can be complicated by insufficient basic information, by lack of understanding of modern technological needs and purposes, and by a tendency to supplant a realistic approach to the question of safety in use with well-intentioned, sometimes passionate idealism. Nevertheless, only on the basis of sound scientific research and leadership can we expect to have practical and enforcible regulation in this increasingly complex field of food additives.



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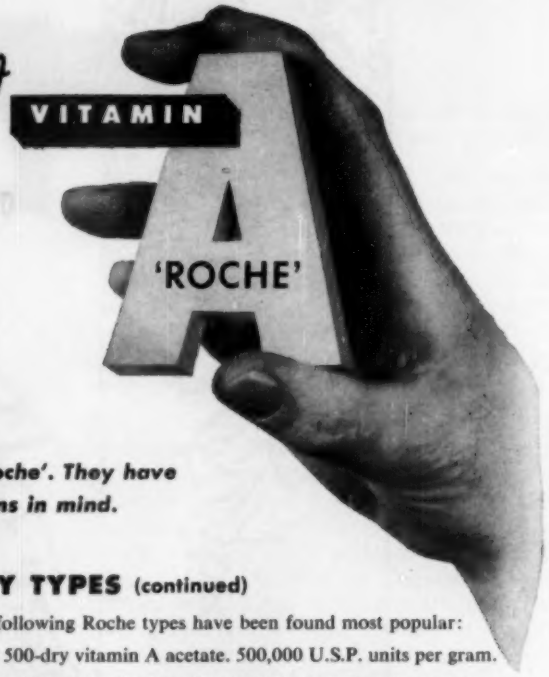

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Type A1MO vitamin A acetate—1,000,000 U.S.P. units per gram, standardized by addition of edible oil. Contains well-proven stabilizing factors of the Roche synthesis.

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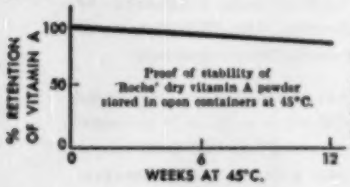
Packaging—All liquid types of 'Roche' vitamin A are packed under inert gas in seamless containers. Nominal quantities are shipped in widemouth aluminum bottles. For large orders, a specially-designed aluminum transport can holding 50 kilos is recommended. A dispensing attachment is available.

DRY TYPES

'Roche' dry vitamin A acetate, and vitamin A and D_2 powders have great advantages.



First, dry vitamin A acetate 'Roche' has high stability in tablets, hard and soft gelatin capsules, and powdered food supplements.

Second, having an irregular surface the Roche product does not separate from other dry ingredients during mixing or vibration.

Third, Roche powders do not stick to machine dies and punches. Capping and spring do not occur during compression.

Fourth, extrusion loss is low. This advantage comes from the product's excellent resistance to the high pressures found in tablet making.

Powdered food supplements use 'Roche' dry vitamin A and D_2 for ease of manufacture.

DRY TYPES (continued)

The following Roche types have been found most popular:

Type 500-dry vitamin A acetate. 500,000 U.S.P. units per gram.

Type 325-dry vitamin A acetate. 325,000 U.S.P. units per gram.

Type 500 A-50D-dry vitamin A acetate and vitamin D_2. 500,000 U.S.P. units of vitamin A and 50,000 U.S.P. units of vitamin D_2 per gram.

Mesh Sizes: Each type available in two mesh sizes: No. 40 and No. 60.

Packaging—All types of 'Roche' dry vitamin A are packed in polyetheylene bags, with protective sealer, in drums and in 1 and 2 kilo tamperpruf metal containers. Small quantities in amber s.c. bottles.

SPECIAL BLENDS

Roche has various potencies of vitamin A in vegetable oil, alone or with beta carotene 'Roche' or vitamin D_2, according to your formula. These are widely used for fortifying margarine and other food products. With a Roche blend of vitamin A and carotene, processors have the advantage of *fortifying* and *coloring* their products in just one plant operation.

Custom-made blends of 'Roche' vitamin A and other oil-soluble ingredients such as vitamin E 'Roche' are also available.

These are packaged in batch size, sanitary tin cans or in bulk packings to suit your manufacturing operation.

Beta CAROTENE 'Roche'

Use 'Roche' beta Carotene to supply *safe, convenient* coloring combined with *nutritional* value for margarine, shortening, butter, cheese, yellow baked goods, edible oils, and other foods.

Beta carotene is the natural coloring matter of butter and other dairy products. It is a constituent of cereal grains, alfalfa, carrots, and other vegetable foods. 'Roche' beta Carotene imparts a *true* natural yellow color to your foods without any trace of green. 'Roche' beta Carotene adds nutritional value; theoretically, one gram equals 1.666,667 millions U.S.P. units of vitamin A activity. Extensive tests show that "Roche' beta Carotene has excellent color stability.

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Preview of the Symposium on Microscopic-Analytical Methods in the Food and Drug Industries

MICROSCOPIC-ANALYTICAL methods for product control in the food and drug industries will come in for evaluation at the 71st Annual Meeting of the Association of Official Agricultural Chemists in Washington on October 15, 1957. Sanitation problems resulting from the presence of insects and rodents, raw materials control, and laboratory testing will be discussed formally in a series of papers and informally in scheduled question and answer periods.

Kenton L. Harris, Associate Chief of the Division of Microbiology, Food and Drug Administration, will serve as General Chairman of the Symposium. Ten papers are planned to provide up-to-date information on plant sanitation practices and laboratory methods. They will present a range of viewpoints from government, industry, and industry consultants.

THE PAPERS:

1. *Introduction* by Kenton L. Harris, General Chairman of the Symposium, Associate Chief with the Division of Microbiology, U. S. Food and Drug Administration, Washington, D. C.

2. *The Food and Drug Inspector Looks at Plant Sanitation.* Kenneth Lennington, Chief Inspector, Bureau of Field Administration, U. S. Food and Drug Administration, Washington, D. C., will discuss plant sanitation from the Food and Drug Inspector's viewpoint, including factors that contribute to plant insanitation and techniques used by the Inspector in evaluating plant sanitation.

3. *Programming of Plant Sanitation Practices—A Consultant's Viewpoint.* Maurice Siegel, Strasburger and Siegel, Baltimore, Maryland, will evaluate sanitation requirements and the setting up, by a Consultant, of a continuing in-plant sanitation program with laboratory control to insure the operation of the plant under sanitary conditions and the production of clean finished products.

4. *The Significance of Mold Count in Canned Tomatoes.* William V. Eisenberg, Chief, Microanalytical Branch, Division of Microbiology, U. S. Food and Drug Administration, Washington, D. C., will analyze factors influencing the mold count of canned tomatoes, the packing medium in canned tomatoes, and those factors that must be considered in interpreting the Howard Mold Count as an index of the use of spoiled tomatoes.

5. *The Structure and Identification of Hair.* Raymond Myers, Department of Zoology, Colgate University, Hamilton, N. Y., will discuss hair structure and its practical application in the identification of hair types.

6. *Laboratory Control in the Canning Industry.* Mary E. Aiken, H. J. Heinz Company, Pittsburgh, Pennsylvania, will present aspects of quality control that are handled by the plant-control laboratory. The viewpoint will be that of the laboratory.

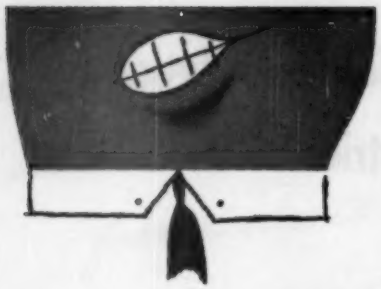
7. *Microanalytical and Microbiological Techniques in Food Plant Sanitation.* V. S. Troy, Continental Can Company, Chicago, Illinois, will consider microanalytical techniques and their effect on over-all production. Observations based on bacteriological plant surveys will be given along with the results of visits to various food plants.

8. *Radiographic Examination of Cereal Grains.* J. Frank Nicholson, Microanalyst, U. S. Food and Drug Administration, Washington, D. C., will report on the radiographic technique as applied to cereal grains. The interpretation of radiographs and the application of this technique to raw material control will be presented.

9. *Practical Aspects of X-ray Testing of Cereal Grains.* Walter Hampe, X-ray Division, Westinghouse Electric Company, Baltimore, Maryland, will give a companion paper to the one above, dealing with practical considerations of time, cost, equipment, maintenance, personnel required in setting up an X-ray testing unit.

10. *Integrated Quality Control.* W. W. Prouty, American Stores Bakery, Philadelphia, Pennsylvania, will bring together all of the various aspects of quality control needed to insure the production of high quality finished products.

11. *A Lawyer Looks at Sections 402a(3)(4).* Vincent A. Kleinfeld, Attorney, Washington, D. C., an eminent legal authority on the Federal Food, Drug, and Cosmetic Act will present the attorney's viewpoint of the pertinent sections of the Act which are the regulatory foundation of the requirements which form the background for the Symposium.



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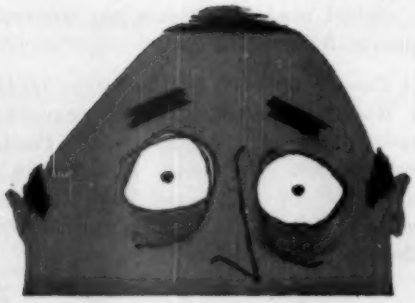

Association of Food and Drug Officials of the United States

Highlights of the Louisville, Kentucky, Meeting

REGULATORY OFFICIALS at federal, state, and municipal levels had a very outstanding meeting in Louisville in May, with many reports of much interest to the processing industries as well as control officials. Particular mention should perhaps be made of the reports by the Committee on Canned, Processed and Frozen Foods, and the Committee on Meat and Poultry Inspection.

At the session on Canned, Processed, and Frozen Foods, Dr. Gail N. Dack (University of Chicago) spoke on frozen foods, Mr. R. W. Kilburn (Florida Citrus Industry) and Mr. Campbell (Sunkist Growers) on the development of standards for various citrus juices and citrus products, and Professor G. L. Marsh (University of California) on nectar and fruit juice standards. The Committee was informed by Dr. Dack and his group that they are prepared to set up and to make a survey in processing plants to correlate bacterial standards with good manufacturing practice. The Committee believes that there is a need for much more work before any recommendations for bacterial standards for frozen foods can be made.

The Committee on Meat and Poultry Inspection, D. B. Schlosser, D.V.M., chairman, and George Michaels, Vice-Chairman, considered poultry legislation at the national, state, and local levels. Consensus of the Committee was that "any Federal poultry legislation must provide harmony between the Federal Inspection Service and the State and local health officials." Federal law governs only a portion of the poultry processed for human consumption. The remainder must be supervised by states and local communities. In the Committee's view these communities should be assured that interstate poultry offered in their respective localities has met substantially the same requirements as those required of local products.

OTHER EVENTS

The Harvey W. Wiley Award for 1957 was made to Mrs. Sarah V. Dugan, Director of the Food and Drug Division, Kentucky Department of Public Health for her 30 years of outstanding services to the consuming public of Kentucky and for her inspiration to others throughout the country in regulatory work.

The report of the Committee to Study State and Municipal Food and Drug Laws was adopted and a preliminary survey will be conducted by Public Administrative Service, Chicago, Illinois. The study will serve as a guide for overhauling and improving the laws, housing and laboratory facilities, and personnel problems of the state and municipal control departments.

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Four-Day Short Course in Fishery Products Held in Oregon in July

OREGON'S GOVERNOR R. D. HOLMES officially opened the Oregon Fish Festival-Annual Astoria Regatta at College Seafoods Laboratory at Astoria on July 18, and thereupon began a four-day short course with perhaps the greatest enrollment of any class in the history of teaching. At the mouth of the West's mighty 1400-mile-long Columbia River stands the moderately populated city of Astoria founded by the fabulous John Jacob Astor almost a century and a half ago. The 12,000 people who call this port of entry home welcomed many more than their number in mid-July.

In August, 1956, a year ago, the first Oregon fish festival sponsored by the Astoria Regatta Association drew some 18,000 visitors to Astoria. At the same time, the visitors were awakened to the importance of Oregon's fishing industry and the values of marine foods through educational and commercial exhibits.

Oregon State College is largely responsible for the Fish Festival. Dr. E. W. Harvey who joined its faculty as a food technologist in fish utilization and marketing at the Astoria Seafoods Laboratory in 1940 was general chairman of the 1957 Oregon Fish Festival and the driving force behind this year's event, held July 18 to 21. He is credited with coming up with the idea of a yearly festival as a means of bringing every possible aspect of Oregon's fishing industry to the consumer.

Impressive cooperative effort. One of the many consumer-attention features was a pushbutton exhibit sponsored by the U. S. Fish and Wildlife Service and the Oregon State College Extension Service named "Test Your Fish IQ." Pushbuttons allowed visitors to make choices of answers to several questions on seafoods. Red and green lights scored the answers. The exhibit was manned by a consumer marketing specialist and a fish marketing specialist.

Another consumer attention-getting device was the "Savory Seafoods Search" in which both men and women competed for seafood cooking honors. Contest divisions included appetizers, chowders and soups, salads, entrees or main dishes, and men's cooking division. Winning recipes from last year's first Fish Festival contest were compiled into a handy recipe file-size printed booklet by Oregon Seafoods Producers Board and made available for free distribution.

Using the theme "Fish Favorites from Far-Away," seafood cookery ideas from foreign countries were demonstrated twice daily at the Astoria Armory. Seafood recipes by nationality included: Austrian, Norwegian, Danish, Scotch, Chinese, German, Armenian, French, Jewish, Finnish, Italan, and Swedish.

Water food resources. According to Oregon State College, more than 60 different forms of fish and shellfish found in waters throughout the state are of commercial importance in Oregon. Many of these were displayed in fresh condition at the Festival by the Oregon Fish Commission; others, difficult to obtain fresh, were depicted by the U. S. Fish and Wildlife Service.

The U. S. Food and Drug Administration showed safeguards that have been established for marketing fish products. The Oregon State College Seafoods Laboratory at Astoria demonstrated various methods of processing fish and shellfish.

Completing "the story of fish from sea to table," the Oregon State College Extension Service conducted continuous cooking demonstrations during the four-day Festival.

FUTURE MEETINGS FOR FOOD TECHNOLOGISTS

August 19-23	Gordon Research Conference on Food and Nutrition, Colby College, New London, New Hampshire
September 8-13	One hundred and thirty-second National Meeting of the American Chemical Society, New York, New York
Sept. 17-24	Thirtieth International Congress of Industrial Chemists, Athens, Greece
September 30–October 2	Fall meeting of the American Oil Chemists' Society, Netherland-Hilton Hotel, Cincinnati, Ohio
October 9-11	Fourth Annual Symposium on High Vacuum Technology, Hotel Somerset, Boston, Mass.
October 14-16	Association of Official Agricultural Chemists, Shoreham Hotel, Washington, D. C.
November 18–December 9	Ninth Pacific Congress of the Pacific Science Association, Chulalongkorn University, Bangkok, Thailand
December 26-31	American Association for the Advancement of Science, Indianapolis, Indiana
April 7-11, '58	The American Association of Cereal Chemists, Netherland-Hilton Hotel, Cincinnati, Ohio
May 25-29	**Eighteenth Annual Meeting of the Institute of Food Technologists, Palmer House, Chicago, Illinois**

An open invitation is extended to readers of FOOD TECHNOLOGY to send in to the Editorial Office, 11606 South Bell Avenue, Chicago 43, Illinois notices of annual or national meetings of interest to food technologists.

One look at the huge, sprawling buildings at one of the Exchange Products plants and you know that big things are happening inside. For here *citrus* is king. Trucks pour in with fresh fruit from groves all over California and Arizona. Conveyer belts hum along in every direction. And Exchange products are shipped to nearly every part of the world.

Why 'Exchange' products serve you better

Utmost cleanliness is the watchword at Exchange Products plants. Everything has that "just washed-down" look. Every four hours, extraction equipment is completely cleaned. Every third day, the entire plant closes down for a thorough washing.

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The world's largest citrus research department is maintained by the Sunkist Growers to develop new growing methods, to improve manufacturing processes, and to perfect better products. Today, with a backlog of more than 60 years experience, Sunkist has accounted for 118 separate U.S. patents.

Just three of many Exchange products are *Exchange Preserver's Pectin*—guarantees a more uniform finished product; *Exchange Low Methoxyl Pectin*—jells *without* sugar, tasteless, controls "weeping" in pies; *Exchange Lemon Juice*—brings out natural flavor of *any* food. Superior acidulant, excellent anti-oxidant.

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These Are the Technical Sessions and Chairmen of the Eighteenth Annual Meeting of IFT, May 25-29, 1958, Chicago

FOOD TECHNOLOGISTS, ENGINEERS, researchers and many others associated with this vast enterprise of ours, the food industry, can look forward to a well-organized and well-led technical program, May 25-29, 1958, in Chicago. Under the general chairmanship of Dr. H. E. Robinson, Director of Laboratories, Swift and Company, the eighteenth annual meeting of IFT is already taking shape.

GENERAL CHAIRMAN
H. E. Robinson

Evidence of this fact is the announcement of the technical sessions that will make up the technical program, just released by co-chairmen of the program committee, Dr. George W. Beach, Manager, General Laboratories, Libby, McNeill & Libby, Blue Island, Ill., and Dr. John M. Jackson, Manager, Research Division Laboratories, of the American Can Company's Research and Development Center, Barrington, Illinois.

Co-chairmen Be[illegible] and Jackson

Announcement of the technical sessions and their respective chairmen is also the occasion for the first call for papers. It is therefore suggested that prospective authors begin to think up titles with which to christen their mental offsprng and to start the processes involved in reporting their projects. The growth of the Institute has brought along with it an ever-increasing competition for a place on the three-day program. Authors of papers to be presented next May can make their reservations for a place on the program by early submission of titles.

SESSIONS AND LEADERS, IFT ANNUAL MEETING, CHICAGO

Radiation Preservation of Foods. Dr. H. W. Schultz. Food Technology Department, Oregon State College, Corvallis, will moderate the speakers reporting progress on the application of radiation to foods. Research projects in this field now number over 100, with much interest overseas as well.

Canning. Mr. W. E. Pearce, American Can Company, Research and Technical Department, Maywood, Illinois, has been selected to chairman the session de-

Pearce (canning) and Hallman (frozen foods)

voted to processing foods for canning. Thermal preservation of food remains the leading form of preservation, with much active research and engineering work in progress.

Frozen Foods. The studies on frozen foods will be presented under the chairmanship of Mr. G. V. Hallman, Campbell Soup Company, Research and Development, Camden, New Jersey. The technology of freezing is becoming well-defined, with current em-

phasis on proper handling to protect the advances being made.

Meat, Fish, and Poultry. Mr. C. K. Wiesman, Research Division, Armour and Company, will lead this tripartite sesson. It is possible that this may be an all-day session—which may also prove necessary for other sessions.

Wiesman (meats, fish, poultry) and Ramstad (cereal and baked products)

Cereal and Bakery Products. Dr. P. E. Ramstad, Technical Director, Products Control Department, General Mills, Inc., Minneapolis, Minnesota, is the man to whom to submit papers in this area of the food industry. Dr. Ramstad is also very active in our brother society, the American Association of Cereal Chemists.

Citrus Products. Always a lively field of inquiry for both scientists and engineers, this subject will be handled in a session under the chairmanship of Mr. H. W. Trumm, Libby, McNeill & Libby, Ocala, Florida.

Dehydration. Mr. R. W. Kueneman of the J. R. Simplot Company, Caldwell, Idaho, will be the moderator for the session on dehydration techniques and products.

Packaging. Although many food papers at an IFT annual meeting have reference to packaging, this session will be devoted to papers on the art and science of packaging with reference to food. Mr. L. J. Hayhurst, Kraft Foods Company, Research Laboratories, 923 Waukegan Road, Glenview, Illinois, will chairman this session.

Hayhurst (packaging) and Crapple (food engineering)

Food Engineering. Mr. G. A. Crapple, Wilson and Company, Inc., Research and Technical Division, 4100 South Ashland Avenue, Chicago, Illinois, has been selected to lead the food engineering session.

Instrumentation. Advances in instrumentation have come thick and fast in the post-war years. Leader of this session is Mr. J. H. Bock, Continental Can Company, Process Engineering, 1350 West 76th Street, Chicago 39, Illinois.

Prepared Foods for Military Use. Foods for the Military, especially those being created for the "Armed Forces of the Future," go beyond conventional food requirements because of the increasing need to "make foods lighter, denser in calories, quick to serve." Dr. R. G. Tischer, the Qm. Food and Container Institute for the Armed Forces, 1819 West Pershing Road, Chicago 9, Illinois, will chairman this session.

Bock (instrumentation) and Tischer (military types of food)

General Research. Papers presented in this session represent many fields—biochemistry, bacteriology, histology, to name but a few. This session at an IFT meeting usually turns out to be two or three sessions. Dr. C. O. Chichester, Food Technology Department, University of Californa at Davis, California, is the chairman.

DEADLINES

Titles of papers must be in the hands of the chairmen by December 1, 1957. Abstracts must be sent in by January 1, 1958. Titles and abstracts should be submitted directly to the appropriate session chairman.

IFT News

INDIANA

The Indiana Section is looking forward to having the Chicago Section as their guest September 28 at Purdue University.

A meeting in the quarters of the Horticulture Department will be followed by a tour of the University facilities.

At noon the combined sections will have a barbecue chicken dinner.

Dr. Emil Mrak, president of the Institute of Food Technologists, presented awards recently to the winners of the essay contest held in connection with the Careers in Food Technology Day sponsored by the Indiana Section of IFT. In the picture, left to right, are Dr. Mrak, Miss Betty Rosenberry, of the Broad Ripple High School Faculty, Miss Judy Ahring, and Mr. Bruce Schlegel, students at Broad Ripple High School and winners of the awards. The Careers in Food Technology Day was a highlight of the 1956-57 program of the Section and has attracted wide attention as a means of communicating the advantages of a career in food research and engineering to students in the secondary schools about to make decisions regarding their future training. —Contributed by W. T. Klinker

The Notre Dame-Purdue football game at Ross-Ade Stadium will be the climax of the day's activities.

Plans are now being formulated for our second annual "Careers in Food Technology Day" to be held in January, 1958. The interest shown by the high school students last year (see *Food Technology*, April, 1957) has given impetus to the movement, and a much larger meeting will be held this year.

S. CALIFORNIA

Schlitz Company of Van Nuys undertook the role of hospitable host for 86 SCIFTers on June 14th. From the spacious parking lot at 7521 Woodman Avenue, small groups were bussed by electric trams to the gleaming white $23,000,000 plant. Here the guides identified the equipment and outlined the manner in which the 5 Schlitz breweries produce six million barrels of light-bodied beer each year. Details of the procedure from the selection of the rice, barley, and hops through the culturing of the wort, washing and returning of the carbon dioxide, to the loading of the freight cars were described.

The social hour between the tour and dinner meeting was spent in sampling the brew in Schlitz Brown Bottle hospitality rooms. Caterers served dinner in these rooms and a formal address, "The Brewing of Beer," was then presented by Brewmaster George Voita. Chief chemist, Oscar Rodde, also spoke, giving insight into that phase of the industry that is under the control of the six chemists at the Van Nuys plant.

—*Cora Miller*

DIXIE

The Dixie Section held a very interesting and informative meeting on May 24 on the University of Georgia campus in Athens. A tour of the beautiful new Georgia Center for Continuing Education was taken by the early arrivals. This very modern building, made possible by the Kellogg Foundation, is one of two such buildings in the United States.

The program was planned especially for the students at the University of Georgia and was put on largely by former graduates of the University. Mr. Miles E. Hess, Manager of Technical Services, the National NuGrape Co., Atlanta, stressed the need for Food Technologists in the carbonated beverage industry, and especially in their traveling laboratories as trouble shooters for the various bottlers. Mr. A. Faegin Parrish, a Food Sanitarian with the Georgia Department of Public Health, Atlanta, told the group how Food Technology plays a role in Public Health. He advised the students to take more science courses. Mr. Richard R. Perdue, of the Cryovac Co., a division of W. R. Grace & Co., Simpsonville, S. C., explained how his Food Technology course had helped in the development of new and better food packaging. Mr. Charles A. Ready, Food Technologist with Crown Food Products Co. and Crown Candy Co., Atlanta, listed some of his wide and various duties as part of a small industry. He emphasized need for a "little knowledge about a great many subjects."

Another interesting speaker was Mr. Ralph M. Bohn, consulting chemist, who told some highlights of his recent business and pleasure trip to Italy.

Officers for the coming year who were installed are: Chairman, Mr. A. S. Perry, Food Consultant of Atlanta; Vice-Chairman, Mr. Cyril Lovvorn, The Dromedary Co., Woodbury, Ga.; Secretary-Treasurer, Mr. William Cown, State Engineering Experiment Station, Ga. Tech., Atlanta; Editor, Miss Cordelia Ellis, Ga. Experiment Station, Experiment, Ga.; Councilor, Dr. J. G. Woodroof, Ga. Experiment Station, Experiment, Ga.

—*Cordelia Ellis*

Masters and Doctors in Food Technology and Related Subjects—1957

The 1957 roster of graduates in food technology is presented herewith. Once again a diversity of problems and a considerable range of approaches characterize the research that has won degrees for the 1957 crop of graduates.

UNIVERSITY OF CALIFORNIA AT DAVIS

Name	*Degree*	*Title of Thesis*
Balatsouras, George D.	M.S.	Fungi Associated with the Softening of Fermenting Olives
Benko, Paul V.	M.S.	Studies on the Submerged Cultivation of Edible Mushrooms
Bettelheim, Frederick A.	Ph.D.	Physical-Chemical Investigations on Pectic Substances
Hoos, Joseph W.	M.S.	Effect of 2,4,5-trichlorophenoxyacetic Acid Spray on the Organic Acids, Pectin and Quality of Canned Apricots
Lahikainen, Toini E.	M.S.	On the Mechanism of the Browning Reaction Between Ascorbic Acid and Glycine
Maier, Vincent P.	Ph.D.	Catalysis of Unsaturated Fatty Acid Oxidation by Hematin Compounds
Miller, Martin W.	Ph.D.	Studies on the Apiculate Yeasts
Nakayama, Tommy (Berkeley, California)	Ph.D.	Carotenoid Pigments of *Rhodopseudomonas spheroides* Mutants
Onaga, David M.	M.S.	Objective Measurements for the Storage Stability of Tomato Concentrate
Patel, Dinesh	Ph.D.	Mechanism of Action of Polygalacturonase from Different Sources of Modified Oligogalacturonides
Plastourgos, Spiros T.	M.S.	Characteristics of Propionic Acid Bacteria Associated with Zapateria Spoilage of Olives
Reiger, Lloyd W.	Ph.D.	Chemical and Physical Changes in Freeze-Dried Meat During Storage
Rogers, Charles	Ph.D.	Isolation and Identification of Some Components of Chicken Broth
Saravacos, George	M.S.	Effect of Fertilizers on the Quality and Chemical Composition of Canned Tomato Juice
Sawyer, Miles F.	Ph.D.	Methodology in Sensory Analysis of Food: Problems Involved in Selection and Training of Judges
Shifrine, Moshe	Ph.D.	Studies on the Genus *Saccharomycopsis* Schionning
Siddiqi, Abul M.S.A.	Ph.D.	Lipoxidases in Nature
Streutker, Robert T.	M.S.	Strain Differences in Brewing Yeasts
Yokoyama, Henry	M.S.	Incorporation of Leucine Carbon in the Carotenoids Formed by *Phycomyces blakesleeanus*

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If your product contains fats or oils you should know about Myverol Distilled Monoglycerides

Myverol® Distilled Monoglycerides is our name for our food emulsifiers that consist of practically all monoglyceride and practically no soaps, catalysts, or free fatty acids. "Myverol" is our trademark. "Distilled" means we produce them by molecular distillation, which is what achieves this exceptional purity. The "Monoglyceride" can come from any food fat, cottonseed oil to prime steam lard.

There's no food emulsifier quite like Myverol, nothing that acts quite the same. For example:

IN CAKE MIXES—with *Myverol* you can add the emulsifier separately, use it to compensate for variations in ingredients.

IN PEANUT BUTTER—you can use *Myverol* as a stabilizer to protect against "oil-out," to give a smoother-spreading product with less stickiness to tongue and palate.

IN HOUSEHOLD SHORTENING—very low levels of *Myverol* do a real job. You can use them after deodorization, and they keep the product in good working condition long after it reaches the kitchen cupboard.

IN ICE CREAM—*Myverol Distilled Monoglycerides*, along with an appropriate stabilizer, can be used to control overrun, produce a product with excellent dryness and melt-down.

In other products, too, like baker's shortening, chocolate coatings, and margarine, *Myverol Distilled Monoglycerides* can make a real contribution to product quality. We'll be glad to work it out with you. To get started, write *Distillation Products Industries,* Rochester 3, N. Y. Sales offices: New York, Chicago, and Memphis • Gillies Inc., Los Angeles, Portland, and San Francisco • Charles Albert Smith Limited, Montreal and Toronto.

distillers of monoglycerides made from natural fats and oils

DPi

Also . . . vitamin A in bulk for foods and pharmaceuticals

Distillation Products Industries
is a division of **Eastman Kodak Company**

CORNELL UNIVERSITY, ITHACA, NEW YORK

Name	*Degree*	*Title of Thesis*
Hong, Leon	M.S.	A Paper Chromatographic Study and Microbiological Analysis of Mevalonate and Acetate
Noble, Edwin Lee	M.S.	The Influence of the Total Solids, Alcohol Insoluble Solids, Starches, and Proteins in Green Peas on the Dehydration Rate
Overly, Darlene Joan	M.S.	The Effect of Variety, Maturity, and Storage on Ascorbic Acid Content of Potatoes as Related to Blackspot
Smith, George C.	M.S.	The Effect of Pruning Severity and Maturation Upon the Tartrate Content of Concord Grape Juice

UNIVERSITY OF GEORGIA AT ATHENS

Balke, William James	M.S.	Water Binding Capacity of Salts and Effect of Antibiotics on the Keeping Quality of Poultry
Blackstock, Hoyt Arthur	M.S.	The Effect of Stages of Maturity on the Thermal Processing Requirements for Canned Field Peas
Zimmerman, Victor Carl	M.S.	The Influence of Anthocyanin Pigments, *In Vitro*, On Certain Microorganisms

UNIVERSITY OF ILLINOIS AT URBANA

Brown, William Lewis	Ph.D.	The Production and Germination Requirements of Putrefactive Anaerobe 3679 Spores
Canale-Parola, Ercole	M.S.	A Microbiological Study of Commercially Prepared Frozen Poultry Pies
Chahine, Mahmoud Helmy	Ph.D.	The Relationship of Dietary Fat and Cholesterol to Serum Cholesterol Levels
Gomez-Farias, Judith	M.S.	No thesis
Kadaba, Lalitha Rangaiengar	Ph.D.	The Electrophoretic Properties of Casein from Sterilized Milk Stored at Different Temperatures
Kendall, Theodore Winchester	M.S.	Some Equipment Design Factors Which Affect the Rate of Freeze-Drying
Lee, Wei Hwa	M.S.	Continuous Culture of *Rhodotorula Gracilis*
Mannheim, Heinz Chaim	Ph.D.	Suitability of Plastic Films and Packaging Material for Heat Processed Orange Juice and Orange Juice Concentrate
Mao, Shui-shung	M.S.	An Ecological Study of *Bacillus Coagulans*
McGill, John Norman	M.S.	The Effect of Gamma Ray Pasteurization on the Stability of Whole Eviscerated Chickens Under Refrigerated Storage
Nishida, Toshiro	Ph.D.	The Effect of Thermally Oxidized Oil and Protein on Serum Cholesterol and Lipoprotein Levels, and on the Incidence of Experimental Atherosclerosis
Olander, John Wester	M.S.	The Development of a Preparation Procedure for the Prevention of Browning in Apple Slices

A vitamin salesman celebrates

By taking his wife (on left arm) and secretary (on right) out to one of Memphis' flossier lunch places, young John Hanrahan prepares to celebrate a morning that went well.

Young John is a salesman by trade. Works for us out of Memphis. Smart boy, nice smile, neat. Job as far as the pharmaceutical trade goes is to get friendly with anybody who has facilities or even just ambitions to manufacture vitamin-A-fortified food products in Dixie.

The friendship ought to be mutual, for 5'8" up from the shoeshine is the pipeline to a group of fellows up in Rochester, N. Y., who have been concentrating for a couple of decades on vitamins A and E. Friends of Mr. Hanrahan are therefore likely to be first to get a phone call when out of the test tubes and the committee meetings comes something new and hot involving vitamin A.

What made John's morning perfect? One of his friends who couldn't wait called him first.

leaders in research and production of vitamins A and E

DPi

The Memphis number is BRoadway 2-1671. The name is ***Distillation Products Industries,*** Headquarters, Rochester 3, N. Y. Other sales offices: New York, Chicago • Gillies, Inc., Los Angeles, Portland, and San Francisco • Charles Albert Smith Limited, Montreal and Toronto.

Also... distilled monoglycerides...
some 3600 Eastman Organic Chemicals for science and industry

Distillation Products Industries *is a division of* **Eastman Kodak Company**

Name	*Degree*	*Title of Thesis*
Perkins, Edward G.	M.S.	No Thesis
Rand, Nissan Tibor	Ph.D.	The Utilization of Fat by the Growing Chick
Read, Carlyle Dean	M.S.	The Stability of Dehydrated Sweet Corn as Determined by Short Time Storage at an Elevated Temperature

MASSACHUSETTS INSTITUTE OF TECHNOLOGY AT CAMBRIDGE

Aikawa, Yaichi	Ph.D.	The Development of Processing Techniques for New Tuna Food Products
Bates, Charles Johnson	Ph.D.	Growth Rate Studies of Sucrose in Corn Syrup Solutions
Brody, Aaron Leo	Ph.D.	Masticatory Properties of Foods by the Strain Gage Denture Tenderometer
Charm, Stanley Ely	Sc.D.	Heat Transfer Coefficients in Straight Tubes for Pseudoplastic Food Materials in Streamline Flow
Fuld, George Joseph	Sc.D.	An Investigation of Automatic Controls as Applied to Fermentation Processes
Mateles, Richard Isaac	S.M.	The Effects of Ionizing Radiations on Some Rheological Properties of Gelatin
Moreau, Jean Raymond	Ph.D.	Investigation of Factors Influencing the Canning of Fish Flakes
Rich, Harold Maurice	Ph.D.	Physical and Chemical Effects of 16 Mev. Electrons on Foods and Their Components
Segall, Stanley	Ph.D.	Chemical Studies on the Stability of Some Components in Coffee Brew
Urioste, Joaquin Mas	S.M.	Studies on the Production of Amylases by *Bacillus subtilis* Using a Submerged Process.

UNIVERSITY OF MASSACHUSETTS AT AMHERST

Brandl, Franz	M.S.	Odor Transmission Through Packaging Materials
Elbert, Elizabeth Mary	Ph.D.	Nitrogenous Constituents of Apple Juice
Gagnon, Marcel	Ph.D.	Biochemical Methods for Determination of Shrimp Quality
Khatchikian, Rouben	Ph.D.	Bacteriology of Frozen Shrimp
Kiratsous, Athanasios	M.S.	Absorption of Oxygen from a Controlled Atmosphere Apple Storage Room
Lampi, Rauno Andrew	Ph.D.	Softening of Salt Stock Pickles
Lemack, Noel Irving	M.S.	Nutritional Value of Fish Scales for Animal Feeding
Roseman, Arnold Saul	Ph.D.	Relation of Certain Factors to the Heat Induced Coloration of Green Beans
Shore, Joseph David	M.S.	Determination of Allylisothiocyanate in Mustard by Gas Chromatography
Yanez-Cortez Enrique	M.S.	Dehydrated Tomato Products

UNIVERSITY OF MINNESOTA AT ST. PAUL

Benson, Harold N.	M.S.	No Thesis
Gander, John E.	Ph.D.	Some Relationships of Dietary Fat to Blood and Fecal Constituents of Dairy Calves and Rats
Glass, Robert E.	Ph.D.	Chemical, Physical and Biological Studies of Rats' Milk and Its Components
Golubchuk, Moishe	Ph.D.	Studies on the Relation of Molds and Mold Products to "Sick Wheat" and Other Types of Damage in Stored Wheat
Good, Don Ladoyt	Ph.D.	The Effects of Diethylstilbestrol Administered by Implantation and by Ingestion on Growth, Fattening and Carcass Characteristics of Beef Steers
Helbacka, Norman V. L.	Ph.D.	Studies on Blood and Meat Spots in the Hen's Egg
Lavers, Marjorie	M.S.	The Effect of Thiamine Deficiency on the Secretory Response of Vagally Innervated Gastric Mucosa
Mahadevan, Vaidyanatha Iyer	Ph.D.	Dilatometric Behavior of Tristearin, Triolein and Mixtures Thereof
Peterson, Arthur C.	Ph.D.	Some Aspects of Bacterial Metabolism of Unsaturated Fatty Acids
Rutledge, Elmer Al	Ph.D.	A Study of Protein and Calcium Requirements of Baby Pigs
Skala, James H.	M.S.	No Thesis
Sumption, Lavon John	Ph.D.	An Analysis of the Early Development of the Minnesota No. 3 Inbred Line of Swine
Wolf, Walter J.	Ph.D.	Physical and Chemical Studies on Soybean Proteins

OREGON STATE COLLEGE AT CORVALLIS

Caspar, John N.	M.S.	Controlling Fermentation with Vitamin K_3
Chuan, Chi-K	Ph.D.	Characterization of Rennin
Jen, Fung C.	M.Agr.	Cane and Beet Sugar and Their Production
Mhatre, Nagesh S.	M.S.	Dilatometric Studies on Milk Fats
Pailthorp, Robert E.	M.S.	Removal of Beet Color from Waste by Treatment with Trickling Filters
Sato, Kunito	M.S.	Effect of Holding Time at 72° F. on the Heat Resistance of Bacterial Spores (P.A. 3679)
Skaar, Roger W.	M.S.	A Sanitary and Bacteriological Study of Farm Bulk Milk Supplies in Linn County, Oregon
Strain, James R.	Ph.D.	Relationships Between Plant Size and Costs of Processing Fluid Milk in Oregon

*Report from Continental's new Research Center**

A Continental Can technician tests food specimens in the thermal death time unit to assure proper food processing.

THERMAL DEATH TIME SYSTEM HELPS IMPROVE PROCESSING OF CANNED FOODS

The thermal death time unit is a vital part of Continental's research program to improve canned food processing. Continental's process engineers use this system to determine the most effective means of killing food-spoiling bacteria.

First, tests are made on food specimens that have been inoculated with typical food spoilage organisms. Placed in cotton plugged tubes, these specimens are rapidly heated and cooled with steam operated equipment. Temperatures for this study range as high as 270 degrees F.

Later the research scientists repeat the experiment, duplicating actual commercial production, processing the food in small cans. After a period of incubation, researchers check to see which organisms survive a given time and temperature of heat sterilization.

These exhaustive studies enable Continental's engineers to recommend the best method for processing canned foods. If you have a processing problem . . . call us. Our engineers will welcome the opportunity to help you solve it.

***TOP AWARD WINNER**

For the excellence of its modern, scientific design, Continental's new $7,500,000 Chicago research center has won the honor award of the Chicago chapter of the American Institute of Architects and the Chicago Association of Commerce and Industry.

QUALITY Continental SERVICE

CONTINENTAL CAN COMPANY

Eastern Division: 100 E. 42nd St., New York 17
Central Division: 135 So. La Salle St., Chicago 3
Pacific Division: Russ Building, San Francisco 4

Name	*Degree*	*Title of Thesis*
Tunnock, Archie Jr.	M.S.	Factors Affecting the Evaluation and Use of Grain Protectants for Insect Control
Uhe, George Jr.	M.S.	The Influence of Certain Factors on the Acidity and Sugar Content of the Jersey Blueberry
Uyeda, Kosaku	M.S.	The Metabolism of C'' Carboxyl Labeled — Benzoic and Phenyl Acetic Acids by *Musca domestica*

RUTGERS UNIVERSITY AT NEW BRUNSWICK

Dean, Robert W.	M.Sc.	A Study of the Redness of Vacuum Packaged Cut Beef; the Effect of Package Type, Irradiation and Treatment with Aureomycin
Epstein, Arnold I.	M.Sc.	An Objective Method for the Flavor Evaluation of Pesticide Treated Vegetables
Raceuis, Vitolds	M.Sc.	The Effect of Internal Structure and Total Solids Content of Potato Tissue on the Color of Potato Chips
Schoman, Charles M., Jr.	M.Sc.	Experimental Evaluation of the Electrical and Temperature Characteristics of a Standard Griddle, Their Interrelationship and Influence on the Grilling Operation
Son, Chung-Hyun	M.Sc.	Structural Changes in Tissues of Pears and Peaches During Storage
Wistreich, Hugo E.	M.Sc.	Curing of Ham: A Study of Diffusion of Sodium Chloride

VIRGINIA POLYTECHNIC INSTITUTE AT BLACKSBURG

Collins, Margaret	M.S.	The Tolerance of Baked Custards for Fortification with Two Types of Non-Fat Dried Milk
Fellers, Paul J.	M.S.	Composition of Processing Varieties of Virginia Apples from Several Localities

UNIVERSITY OF WISCONSIN AT MADISON

Beyer, William	M.S.	The Effect of Insecticides and Fungicides on the Physio-Chemical Properties of Canned Red Sour Pitted Cherries
Douglas, Robert R.	M.S.	Studies on the Protein Stability of Frozen Concentrated Milk
Gammack, David	M.S.	Some Effects of Two Stage Sterilization on the Physico-Chemical Properties of Evaporated Milk
Giroux, Roger N.	Ph.D.	A Study of the Physico-Chemical Changes in Concentrated Milk
Olson, Norman F.	M.S.	A Study of Factors Influencing Body of Process Cheese Spreads
Shenkenberg, David R.	Ph.D.	Effects of Ultrasonic Waves on the Heat Stability and Flavor of Milk

New "Built-in" Process Refractometer Assures Continuous... Accurate... Easy Quality Control

The internationally known GOLDBERG PROCESS REFRACTOMETER is designed for the continuous precise, rapid and easy determination of total soluble solids... in turbid and dark-colored concentrates, jellies, jams, pastes, purees, juices, syrups, preserves, milk products ... and in other solutions.

Three models are available in Brix ranges: 0 to 25%, 12 to 72% and 36 to 82%. Any model can be mounted on the side wall of a process vessel, evaporator, vacuum pan, fruit spread cooker, product pipe line or other location where continuous reading is desirable. The refractometer may also be mounted into a fixture that runs onto a track above a row of kettles for sample ladling.

The unique optical system transmits a sharp transition line from light to dark onto the large .5% graduated scale in the focusable eyepiece.

The illuminating unit consists of a 6 volt, ¼ ampere, long-life bulb ... detachable socket and cord.

The compact and rugged refractometer when mounted into the process vessel is vacuum and pressure-tight ... designed to withstand pressure of 20 pounds and temperatures ranging up to 110°C (230°F). The instrument is readily removable from coupling flange.

Instruments are factory calibrated. Recalibration to operating temperature is accomplished by a simple exterior set screw adjustment. A manually-operated wiper always brings fresh product sample to the prism face.

The GOLDBERG PROCESS REFRACTOMETER offers the following important advantages: accurate readings are instantaneous ... withdrawal of sample not necessary... evaporation errors eliminated... readings unaffected by viscosity, foam, air bubbles and pulp... no operator training period is required.

Why not write for further details today!

American Optical Company
Instrument Division, Buffalo 15, New York
Dept. T190
Gentlemen:
Send complete information on:
☐ Goldberg Process Refractometer
☐ Goldberg Combination Hand and Dipping Refractometer

Name _____
Address _____
City _____ Zone _____ State _____

A report on the

DIETETIC MARKET

. . . and the vital opportunity it presents to you

This report on the rapidly accelerating dietetic market is written to every food executive who has a product in this field . . . or is thinking about having one.

As you, of course, know, this market has had a phenomenal growth—and the end is nowhere in sight. If you are about to introduce a product in this field—or if you have a product that has not grown as fast as the field—we believe you will be interested in the facts on this market that you will find on the inside pages.

These facts are presented in three sections: (1) the dietetic market itself, (2) the new trend in dieting, and (3) the vast opportunity that lies ahead.

The already wide market for low-calorie foods is increasing rapidly

The best estimates indicate that almost half of the adults in America are overweight or concerned about their weight—and hence are interested in low-calorie products. According to competent research, the actual figure is 49.2%. This means that over 60 million Americans will be dieting during the year—about 20 million at a time—on a constant turnover basis.

Who are these people and where do they live? They are both men and women (more women, of course) in all age groups and all occupations. As they rise in occupational group rating and in buying power their concern with overweight increases—and so does the action they take about it. People who earn more live better and eat better—but they are becoming more and more particular about how many calories they take in.

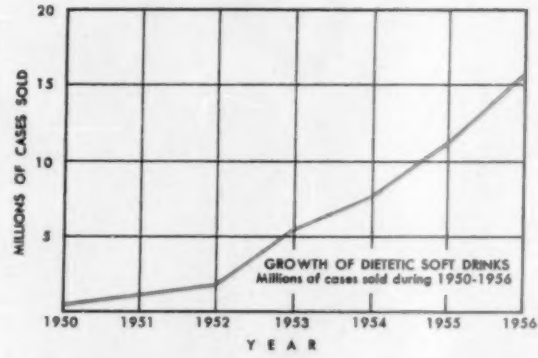
The location of overweight people or those concerned with overweight is nation-wide—showing little sectional difference. As you might expect, people living in the larger cities tend to be more interested in the dietetic products, but the spread from the rural districts to the largest cities is relatively small.

The interesting thing to food and beverage processors is that this market is the fastest growing market in the food industry today, and there is nothing on the horizon to indicate a slow-up.

Food Store Operators Recognize Trend

The food store operators are aware of the potential profits in dietetic foods—and are giving this new field both ad and shelf space. Today there is virtually no major food store in the country without a low-calorie food section—and these sections are expanding in shelf space at a time when shelf space is at an all-time premium. As an example, dietetic foods increased 17% in shelf space during a period when canned fruits lost 79% of their shelf space. Dietetic foods also gained over cereals, baby foods and canned juices. Super market buyers themselves have obviously decided that the greater profit, demand and turnover of low-calorie foods have earned this added shelf space.

In the June 1956 issue of Food Topics it shows that dietetic foods have "an average profit return of $1.07 per square foot of floor space—compared to 37¢ for baby foods and 28¢ for cold cereals."

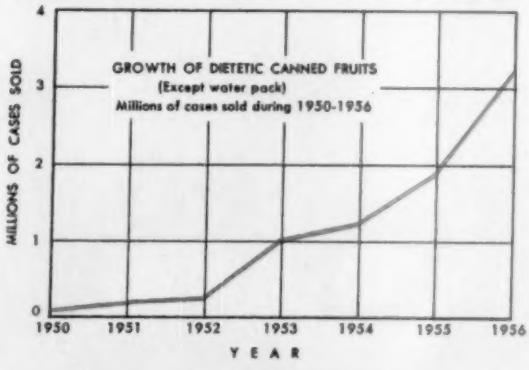


The list of dietetic foods found in typical sections is long and growing longer. In one typical food store in Baltimore, for instance, we counted over 200 food and beverage items that would appeal to the dieter.

Not all of these are "low-calorie" foods; some are simply salt-free. But they mass together to make a special diet section where more and more women are doing their everyday food buying. Bottlers of soft drinks are well represented and so are canned fruits, jellies, jams, preserves, ice cream, puddings, cake mixes.

$250,000,000 Volume

In terms of dollar volume, at retail, careful estimates suggest that the total market for all types of dietetic foods and beverages is now about $250,000,000. This is an estimate, of course, but we believe the estimate to be reasonably reliable. The dietetic product is *already* a staple.



the DIETER

Dieting is taking on a new meaning today

Once this dieting business was a fad—sometimes a dangerous one. Now, however, dieting has become a healthful way of living in millions of American homes. The public is being made aware of the fact that a sensible, sustained dieting program is the only way to achieve and maintain proper weight. Going is the old-style dieter who went on a dangerous diet for a length of time and lost a prescribed number of pounds, only to climb back on the calorie bandwagon and put the pounds back on.

The Slim Figure Is Today's Ideal

The slim figure has become an important symbol today. Doctors tell us that overweight people don't live as long as people who carry ideal weight. And more importantly, it is much more harmful to the system to take weight off and then put it back on than it is to carry on at a continued overweight level.

Supplementing the health factor is today's social emphasis on the slim figure as a symbol of style, modernity, beauty or virility, romance, healthy mental adjustment and even success.

Advertising has taken up a theme of new style dieting to sell many products. Advertising is promoting the idea that modern living implies a state of good health that comes of staying slim.

Television, magazines and newspapers are also major factors in furthering the idea of slimness, both with direct dietetic editorials and features, and with a flood of styles in fashion news. Sensible eating is probably today's No. 1 "health editorial" subject.

A Diet-Attitude Study

To learn the effect of this national educational program, Abbott Laboratories sponsored a psychological study of typical consumers. 42% said they were overweight. 49% said they were just right. Only 9% thought they were underweight. In this study, Abbott Laboratories was looking into attitudes towards weight. Abbott tried to learn why these people went on a diet, if they stayed on it, how they felt about it. Here are some of the conclusions that came out of this research:

1. The fear of being overweight is general and very real.
2. Reliance on exercise as a means of taking off weight is a negligible factor.
3. Most dieters would like to lose weight and keep weight off as painlessly as possible.
4. Most dieters recognize calorie-restriction as the logical way to stay slim.
5. Most dieters have an inordinate "sweet tooth." They would like to satisfy their craving for sweets while counting calories.
6. Most dieters (3 out of 4) give weight control as the reason for dieting. One out of 4 had other reasons—diabetes, heart conditions, pregnancy, ulcers, etc.

A National Family Opinion Study

Abbott Laboratories was interested in those dieters who used a non-caloric sweetener. For this reason in a market study in 1956 Abbott asked the National Family Opinion Panel of 2,000 families to tell how they used their non-caloric sweetener. The results:

Product Use	Sucaryl	Branded Sacch.	Unbranded Sacch.
1. Sweeten Beverages	77.6%	79.2%	92.9%
2. Dry Cereal	24.1	41.6	14.9
3. Cooking-Baking	29.0	10.4	11.0
4. Fruit	6.5	—	1.1
5. No Answer	7.5	12.5	3.3
Totals*	144.7%	143.7%	123.2%

**Over 100% due to duplicate answers*

Note—on items 3 and 4 above—the good percentage of dieters who prepare their own diet recipes at home. This suggests a major opportunity for any diet product that can be served right from the can, jar or package—thus eliminating kitchen preparation. In effect, a diet product becomes a *convenience* product. As you see, Sucaryl was preferred over saccharin by about 3 to 1. The significance is clear. If a canned or packaged diet food is sweetened with Sucaryl it already has a pre-sold market.

the OPPORTUNITY

Make the most of the dietetic market

with Sucar

(it's the non-caloric sweetener your customers already know and use)

Dramatic new opportunities are all-important in the ever-changing food business. Dietetic foods are today's opportunity.

The low-calorie foods business asks the food store operator for no other investment than shelf space. And this he's proved quite willing to give. The idea of dieting has been pre-sold to the public by every medium that influences American thinking. You or anyone going into the low-calorie market today can take advantage of a more specific kind of pre-selling. This is the pre-selling that has been done by Sucaryl, the non-calorie sweetener that leaves no bitter aftertaste. More than all other brands put together, Sucaryl means "calorie-free sweetness" to the American public.

Briefly, Sucaryl is a brand of cyclamate supplied in bulk to canners and bottlers either in powder or liquid form. It has 30 and more times the sweetness of sugar, leaves no bitter aftertaste in normal concentration—contains no calories. It is completely stable to both heat and cold, entirely compatible to both natural and artificial flavors. The most important thing, perhaps, to you is that the substitution of Sucaryl for sugar ordinarily requires no change whatever in your manufacturing process.

With a product sweetened by Sucaryl you offer the public a natural tasting, fully sweetened substitute for fattening dishes or drinks—help the average dieter resist the constant temptation from life-long eating habits. You do this successfully because the average user cannot tell by taste that he is using a product with a non-caloric sweetener.

Dieters Know and Trust Sucaryl

For home and personal use, Sucaryl outsells all other branded non-caloric sweeteners combined. The use of the Sucaryl seal on your can, bottle or package prepares customers for your product before they even taste it.

No other non-caloric sweetener even approximates the volume, coverage and use-variety that characterizes Sucaryl advertising. Full color ads appear every

month of the year in the magazines shown below, with readership in the hundreds of millions.

Such advertising, along with the unprecedented growth of the dieting habit, has raised Sucaryl dollar sales spectacularly. They have gone up over 500% since 1951. Such figures would not have been possible had not the product been right and the market ready—both factors are of great importance to you. We sincerely believe that any low-calorie product clearly aligned with Sucaryl has an advantage over one that is not. The logical thing would simply be to display Sucaryl on your label, on your store displays and in your advertising to reach the huge pre-sold dietetic market.

What To Do Next

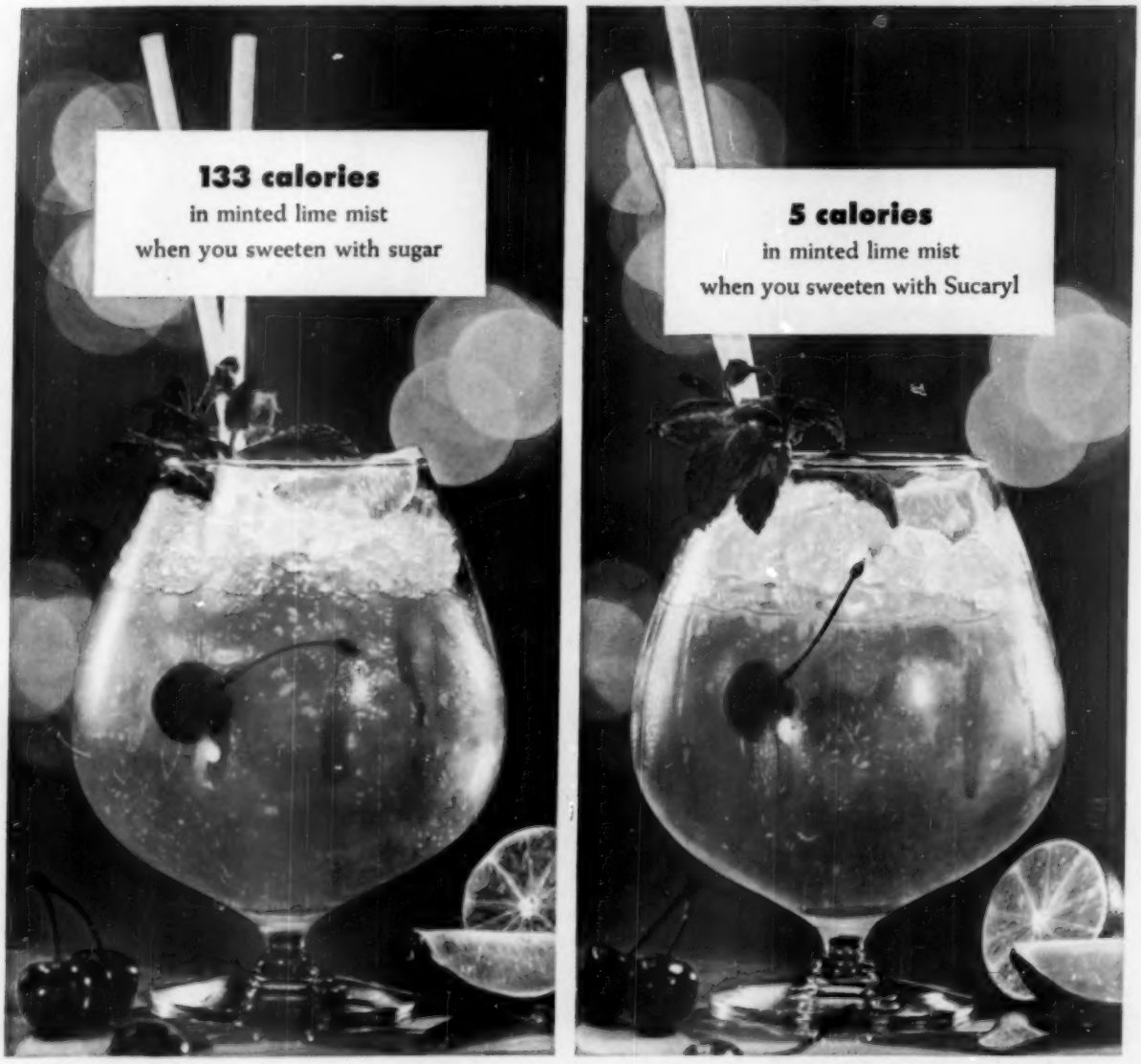
For complete information about Sucaryl and its usefulness to you, we suggest you write for a copy of our booklet, "Making The Most Of The Dietetic Market With Sucaryl." Please address Abbott Laboratories, North Chicago, Illinois. On request, we will also send you a sufficient supply of Sucaryl for your own test purposes.

Please Send Booklet

"MAKING THE MOST OF THE DIETETIC MARKET WITH SUCARYL"

To:
NAME: _____
(Please print)
FIRM NAME: _____
ADDRESS: _____
CITY: _____ STATE: _____
YOUR TITLE: _____

Here's Sucaryl's "ad-of-the-month" for July and August



You can save a lot of calories by sweetening with Sucaryl

and you can't taste the difference

Sucaryl makes it easier for you to watch your weight...by giving you wholly natural sweetness in your diet... without one single calorie. You'll find Sucaryl sweetens all your favorite summer beverages—lemonade, limeade, iced tea, iced coffee—to perfection. Use it for fruits and cereals; cook with it, bake with it; use it practically anywhere you would sugar. Any Sucaryl-sweetened dish tastes just like its sugar-sweetened twin. Sucaryl, of course, is for anyone sensibly counting his or her calories, and for those who cannot use sugar. You get Sucaryl in tablets or solution; low-salt diets call for Sucaryl Calcium. Abbott Laboratories, North Chicago, Ill. and Montreal. Abbott

MINTED LIME MIST

2 cups warm water	1½ teaspoons Sucaryl solution
½ cup fresh lime juice	1 pint dietetic lime carbonated beverage
½ tsp. mint extract	
4 drops green food coloring	

Mix all ingredients except beverage. Chill several hours in refrigerator. Add beverage, pour in glasses filled with crushed ice. Garnish with maraschino cherry, wedge of lime and fresh mint. 6 servings.

Sucaryl®

Non-Caloric Sweetener—No Bitter Aftertaste

The Institute of Food Technologists— In Retrospect and In Prospect*

Geo. Garnatz

Past-President, Institute of Food Technologists, 1956-57

THE YEAR between the sixteenth and this seventeenth annual meeting of the Institute of Food Technologists has been a busy, interesting and stimulating one for me. It has been replete with pleasant experiences. It has provided me with many opportunities to gain insight into and appreciation of the activities of the Institute. It has been thrilling to experience the ready willingness that I have found in every quarter to cooperate in the work of the Institute. The requirements of the office of President are heavy and demand much of the incumbent's time, but it must be admitted, too, that the opportunities for serving, for acquiring new friends as well as for personal development are great. Consequently, as I contemplate the end of my tour of duty, I have experienced no disillusionment and am confirmed in what I said nearly a year ago; namely, that I have been singularly honored by being elected to the high office of President of the Institute of Food Technologists. Again, I wish to express my great appreciation to the membership for this honor. At the same time I want to take this means to thank, genuinely, every individual who, in one capacity or another, contributed to the forward progress of the Institute during the year now concluding.

The insight into the workings of the Institute that I have gained and the appreciation that I have developed as a consequence of my service, are two things that I covet for every individual member. It emphasizes in my mind again the value of taking an active part in the Institute's activities, for the dividends that accrue to the individual in terms of growth and stature overshadow any contribution one may make. This is an observation that I especially want to point out to the younger members. Active participation in Institute affairs provides an unusual springboard for the launching and development of one's professional career.

In line with this train of thought, one of the objectives this past year has been to encourage a greater measure of communication between the Institute at the National level and at the level of the Regional Sections. This was the intent behind the visits Dr. Mrak and I made to the Regional Sections, the President's letters that went out on two occasions to Regional Section Chairmen and on another to the entire membership, and the activities of the Public Relations Committee. It is to be hoped that efforts along these lines will be continued and added to, for conversancy with the activities and objectives of the Institute can do much to avoid misunderstanding and encourage more general participation in its affairs.

In the time that has been allotted me, I shall confine my remarks to the activities of the Institute in order to capitalize on this opportunity when so many of you are present, to share with you the insight I have gained concerning it.

THE INSTITUTE HAS DEVELOPED REMARKABLY

The Institute has developed remarkably since it was organized in 1939 by approximately 100 founder members. There has been a steady growth in membership so that currently, in round numbers, it stands at 4900. It includes representatives from the academic and research fields, together with technical people in the food processing and allied industries, a considerable percentage of whom hold executive positions with their organizations.

In 1949, national headquarters were established in Chicago with a full-time Executive Secretary. At that time the journal, FOOD TECHNOLOGY, had a total circulation of slightly less than 3000 and the financial resources of the Institute amounted to approximately $16,000.00.

In the next 7 years the circulation of FOOD TECHNOLOGY increased to 6000. In 1950, the journal, FOOD RESEARCH, was acquired and the growth and improvement in quality of this journal as well as FOOD TECHNOLOGY have been consistent.

The financial position of the Institute presently, is quite different from that of 1939 or even 1950. Today, the Institute's cash resources are in excess of $160,000.00, thanks to careful, thorough, and farsighted planning. The approved operating budget for 1957–58 is $169,119.00. FOOD TECHNOLOGY has evolved from a barely "break-even" operation to one that today is returning a modest profit. FOOD RESEARCH has been increased in usefulness through an increase in its content of research papers. It is not a profitable venture and was never expected to be one.

Over the years, there has been a steady increase in Regional Sections. Today, the count stands at twenty-nine. The charter of the Hawaiian Regional Section was presented last year at the annual meeting in St. Louis. Shortly after the turn of the calendar year, Dr. Mrak presented its charter to the Regional Section in Mexico. On March 29, the President presented the Wisconsin Regional Section with its charter and, as recently as May 8, had the honor to present a charter to the Regional Section in Minnesota. Just yesterday, the Council granted a charter

* The President's Address, presented before the Institute of Food Technologists, assembled at their Seventeenth Annual Meeting, Pittsburgh, Pennsylvania, May 13, 1957.

to the very newest Regional Section at Kansas City, Missouri.

OUR OBJECTIVES

As a background to some of the other things I want to bring you this morning, it might be well for us to take a minute or two to review the objectives of the Institute. In Article IV of the constitution we find that, "the particular business and objectives of said corporation shall be a non-profit, professional educational association to promote the application of science and engineering to the production, processing, packaging, distribution, preparation and utilization of foods; by stimulating investigations into technological problems arising therein, and providing a medium for promulgating and discussing the results of such investigations; by stimulating and providing means for the free interchange of technological information and ideas among food technologists; by promoting recognition of the role of food technologists in the technical direction of operations in these fields; all of these endeavors having the ultimate objective of providing better and adequate foods for mankind."

In the pursuit of these objectives, the Institute has experienced again, a very active year. On the heels of the annual meeting at St. Louis, through arrangements by its Chemicals in Foods Committee, the Institute was officially represented at the Perkin Centennial where a symposium on "Colorants in Food" was presented by selected members. From all reports, the symposium was of such high quality that it reflected well on the Institute and so I want to publicly thank those who made arrangements for and participated in this cooperative assignment.

In June, 1956, by invitation, the Institute was represented by an official delegation at the meeting held in Washington, D. C. commemorating the 50th anniversary of the establishment of our Federal food and meat inspection laws. Further recognition was accorded through having the President participate in this commemorative program.

OUR COMMITTEES

Much of the constructive work of the Institute is carried out through committees. I was astounded to learn, and I am sure you will be too, that in line with many of its objectives, the Institute works through at least 30 committees involving the services of about 240 members.

Supplementing our fine editorial staff, the Publications and Advisory Advertising Committees concern themselves with our journals to recommend policy and plan ways and means whereby the journals will constantly improve in quality, render an important form of service to subscribers, and operate on a sound financial basis. As late as April 17, these two committees met jointly and within the relatively near future changes intended to enhance FOOD TECHNOLOGY in the opinion of the reader and the advertiser will be noted. Through its journals the Institute does an impressive job of "stimulating and providing means for the free interchange of technological information and ideas."

The Awards Committee implements the Institute's efforts to "stimulate investigations into technological problems," "to promote the recognition of food technologists" and to interest young people in food technology as a profession. The functioning of this commitee is extensive and important. This year, in addition to administering the Babcock-Hart and International Awards, the General Foods, and Florasynth Scholarship Awards, it revised the Gerber Scholarship Award and launched the Samuel Cate Prescott Award, honoring the "father" of the Institute of Food Technologists.

The Awards Committee has indeed been a busy and productive unit. Besides its established administrative activities, through sub-committees, it has been devising means for achieving more wide-spread publicity concerning our scholarship awards to interested educational institutions as well as to the trade and public. Other sub-committees have been studying plans for the probable establishment of awards for new food processes and new food products. Most recently the American Institute of Poultry Products has indicated a desire to sponsor an award in its fields of interest to be administered by the Institute. This is now in the conference stage between the Awards Committee and the American Institute of Poultry Products. Now, the Appert Medal, sponsored by the Chicago Regional Section, by vote of that section and concurred in by the Council, henceforth will be administered by the Institute.

I am sure that in taking you briefly behind the scenes in the functioning of this committee and in giving you the opportunity to appreciate the heavy schedule maintained, you will share with me the gratefulness I feel toward all those who through service on this committee or its juries have rendered significant service to the Institute and our profession.

ADVANCING THE STATUS OF FOOD TECHNOLOGISTS

I think I am safe in saying that everyone in this room is aware of our moral obligation to advance the professional status of the food technologists, to encourage young people to consider food technology as a career and to assist in evolving the basic elements to be included in food technology courses. This year, in an attempt to accelerate progress in these areas, the Committee on Education was condensed in size and organized into two compact sub-committees capable of meeting reasonably frequently in a body. The efforts of the Committee on Education have been fruitful. It has arranged the session on Industry and Education to be presented Tuesday afternoon. On Sunday, the Council was given "the facts of life" on accreditation by Dr. William K. Selden, Executive Secretary of the National Commission on Accrediting. The Sub-Committee on Accreditation has also taken a

significant forward step by proposing a basic curriculum embracing the fundamental sciences common to all types of food technology training. Time does not permit giving details but, at long last, we have something on which to focus our thinking in an effort to bring order out of chaos on the question of what ground should be covered in training food technologists at the under-graduate level. It is my hope that the products of this year's activities will be reflected in and will influence whatever further study is expended in this area to reconcile divergent viewpoints and refine details to the point where the resultant basic curriculum will find wide application.

The Sub-Committee on Professional Status has also been diligent. This group has concluded that the question of professional status is secondary at this time and should wait until the primary program of education of parents, high school students and high school science teachers, on what is meant by food technology and the advantages that reside in food technology as a career, is launched. Through its deliberations the Sub-Committee on Professional Status has done an effective job of boiling down the problem to a list of eight recommendations based upon which action can be taken.

The Public Relations Committee was established by immediate Past-President Clifcorn to fill a need for improved communications between the committees and the membership. Another objective he had in mind was to encourage and assist the Regional Sections in projecting to the public an awareness of and appreciation of the contributions of food technologists and the food industries to the public well-being.

OUR REGIONAL SECTIONS

Last year, emphasis was placed on communications and, in the interests of continuity, effort along these lines was continued this year. There was also instituted a program to enable Regional Sections to establish speakers bureaus. The effort has not been without success. Nine Sections have already taken the first steps by appointing chairmen to organize their bureaus. Eighty volunteer speakers have already been enlisted in seven of the Sections. The Philadelphia Section itself, has twenty-five speakers lined up.

I cannot refrain from pointing out that here is a real opportunity to serve our profession and the food industries constructively while at the same time building up the vitality of our Regional Sections by providing another line of activity. Here is an opportunity to provide the public with an understanding of the constructive things that are done to provide wholesome, nutritious foods and thus create a mental atmosphere against which the public can gauge in better perspective the sporadic, negative criticisms that are levied against some developments in the fields of food and nutrition.

The Regional Sections constitute another front by which the Institute's objectives are implemented. They are basic to the continued virility of the Institute, provide an excellent medium for member participation and expression and provide the springboard by which younger members especially can grow and develop professionally.

During this year Dr. Mrak and I have been able to visit most of the Regional Sections and we found the experience pleasant, stimulating, and worthwhile. I am sure I speak for him as well as myself in expressing gratitude for the hospitality and the many courtesies extended us. In general, it was assuring to note the activity and interest in the areas visited.

I am sure you will recognize that my intent is constructive when I say that there is opportunity for stepping up the tempo of Sectional activities. Some Sections are facing real problems in providing their membership with a provocative activities program. In others, their full potentialities have not been achieved. Pretty generally, I perceive the need for the development of a greater degree of professional consciousness and pride. More consistent effort must be put into selling food technologists and food technology to management and the public.

Regional Sections would do well to re-assess their activities with a view to building them up. To this end the resources within each Section should be marshalled. At the national level the Institute should apply itself to assembling sectional program aids and act as a clearing house in passing along successful projects instituted by one Section or another.

ATTRACTING YOUNG PEOPLE TO CAREERS IN FOOD TECHNOLOGY

On the other hand there was also evidence of many worthwhile and constructive things being done by the Sections. I should like to cite three examples that came to my attention during my visits to the Sections. As one means of attracting young people to food technology as a career, the Maryland Section collaborated with the Vegetable Growers Messenger to bring to its readers through its December 1956 issue, a series of articles on ways in which the food technologist functions. Other Sections might well emulate the Indiana Section which very successfully staged a career guidance program through which it reached approximately 65 high school students and, what may be significant for the future, several high school counsellors. Out of this experience the Indiana Section has been encouraged to plan a program for next year to cover the entire state. It was my pleasure to attend the Northeast Section's annual Students Night meeting. Forty-four embryo food technologists were present as guests. I am sure that from such a manifestation of interest and friendliness, these young people derived a great measure of encouragement and even inspiration. Yes, there are many untapped areas to be made use of in sectional programs. I urge those who have assumed the responsibilities of leadership in the Regional Sections to forsake orthodoxy and to make an earnest endeavor to provide programs that will draw large numbers of members into them.

OUR ANNUAL MEETINGS

Our annual meetings constitute still another means by which the Institute works toward its objectives. This seventeenth meeting is a typical example and is the culmination of much effort on the part of the committees which have arranged it. These committees have labored long and diligently to provide 4 days packed with information and pleasure. Our thanks go to them for a job well done.

The technical program measures up to the high professional standards established at previous meetings and is so varied in its content that there should be something of value in it for everyone present. It constitutes an excellent vehicle for bringing one's self-up to date on the latest developments in the rapidly growing field of Food Technology.

The Symposium on Sensory Testing is a new venture. It deserves a full attendance since the subject to be covered is so fundamental to many food problems and the application of sensory testing is called for in many food laboratories.

There is much educational and informational value in the exhibits. Some time can be spent on this phase of the meeting with profit, for here is assembled the latest developments in materials and machines for utilization by the great Food Industry.

Some time has also been set aside for fellowship and for enjoying the features, scenic, historic and industrial afforded by Pittsburgh and its contiguous environs. There will be opportunity to talk shop on a person-to-person basis, to re-establish old contacts, and make new friends.

These are some of the elements from which an Annual Meeting are compounded. I hope you will make the most of them. I hope too, that our seventeenth annual meeting may be one that will stand out in your memory for its contribution to your professional development, for old friends met and new friends made and for other pleasant experiences that will send you back to your job refreshed and revitalized.

IN GRATEFUL ACKNOWLEDGMENT

This story of the workings of the Institute cannot be concluded without some mention of the national office. Without it, the organization could not function, for the Institute has grown too large and too complex to rely solely on volunteer effort. This year, more than ever before, I have had an opportunity to appreciate the efficient, enthusiastic and devoted service rendered by the staff. It is through the national office that the routine and details of the Institute's functioning are provided for. For those, who at any given time, are invested with the responsibilities for shaping Institute policies, the office can be depended upon to supply information and guidance of great value which at the same time lends continuity and coherence to the forward progress of the organization.

Certainly my experience at first hand leads me to extend to the staff my personal and great appreciation for all the assistance and counsel given me. I am confident that I express the sentiment of the Institute generally in acknowledging with gratefulness the contributions to the work not only by the Executive Secretary and his staff, but by the Editorial Staff as well.

Thus is summarized another chapter in the active existence of the Institute of Food Technologists. For the part I had to play in it, I feel greatly privileged and honored. In discharging the duties of President and in representing the Institute, I hope that in some measure I may have measured up to your expectations and vindicated your judgment in selecting me as your President. With the conclusion of this meeting I shall transfer my responsibilities to the capable hands of Dr. Mrak. I commend him to you and ask that you extend to him the ready and generous cooperation and support you have given me. Remember, the dividends that accrue to the individual from service to the Institute, in terms of professional growth and development, overshadow whatever investment is made in time and effort.

Film Packaging of Heat Processed Orange Juice Products[a]

I. Some Factors Affecting Stability of the Product

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PLASTIC FILMS for food packaging have become increasingly important. They offer several advantages over rigid metal containers, such as less weight and space when empty, transparency, and wide range of permeability, size, strength and flexibility.

In order to ascertain the suitability of flexible films for packaging of orange juice it was necessary to investigate factors affecting the stability of the product during prolonged storage. There was contradictory evidence in the literature that implicated either peel oil or pulp as the cause of flavor deterioration of canned orange juice. Therefore, it was decided to study these two components using a new approach; namely, to investigate the effect of peel oil and pulp on flavor deterioration of heat processed juice, using both natural and synthetic mixtures analogous to natural juice. In addition, it was necessary to study the proper processing time and temperature relationship to obtain a juice which is microbiologically sterile and enzymatically inactive. Also, since transparent packages were to be used, the effect of light on the product during storage had to be investigated.

Several theories *(13)* have been proposed to account for the development of objectionable flavors in canned and frozen orange juice. The theory that atmospheric oxygen was the cause of off-flavor development can no longer be considered valid *(9)*. Another theory *(1, 2)* proposed that peel oil in low concentration may be responsible for the "terebenthine" off-flavor formation. However, Curl and Veldhuis *(3)* and Guyer and Boyd *(4)* concluded that peel oil is necessary for characteristic juice flavor and does not contribute to off-flavor development. On the other hand Curl and Veldhuis *(3)* observed that the fraction responsible for most of the off-flavor formation was the suspended material which includes the lipid fraction. Rouse *et al. (12)* also found that increased amounts of pulp in juice had a direct effect on deterioration of the juice quality. They concluded that filtered juices showed considerably less flavor deterioration than unfiltered juice.

Several investigators *(6, 7, 8, 11)* studied the lipid fractions in stored orange juice. However, little correlation between changes in these components and juice deterioration was established.

MATERIALS AND METHODS

Heat exchanger. In order to flash sterilize the orange juice or concentrate a special heat exchanger was built (see Figure 1). This consisted of a black iron pipe, 48 inches long and 4 inches in diameter, in which 25 feet of ⅛ inch I.D. aluminum tubing was installed. The ends of the iron pipe were sealed with pipe caps. Juice was pumped through the tubing with the aid of a homogenizer pump. Hot water at a controlled temperature was circulated in the iron pipe to heat the juice in the tubing.

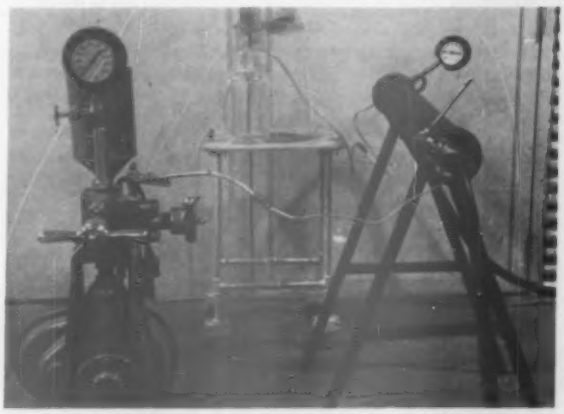

Figure 1. Heat processing of orange juice: Heat exchanger (right), pump (left), filler bottle (center).

Juice preservation. Processing times, temperatures, and preservatives were studied in one experiment. Freshly squeezed juice from Florida oranges was used. The following treatments were applied to separate two liter batches:

Temperature ° F.	*Holding time min.*	*Preservative 200 p.p.m.*
160	0	none
160	10	none
190	0	none
160	0	Sodium Benzoate
160	0	Sorbic acid
160	0	Sodium sulfite calculated as sulfur dioxide.

After treatment, the juice was filled into .005 in. Mylar-.002 in. polyethylene bags, sealed and immediately cooled. Half of the samples were placed in storage at 0° and half at 100° F. Sam-

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ples were organoleptically examined initially and after one, two, three, and five weeks of storage.

A separate experiment was conducted to find the optimum process temperature for cloud stabilization. For this purpose 500 ml. samples of single strength and concentrated juice (a 4:1 frozen commercial brand) were run through the heat exchanger. For single strength juice 170, 190, 200, 210 and 220° F. temperature settings were used, while 200, 210, 220, 230 and 240° F. processing temperatures were used for the concentrate. The time for the juice to pass through the heat exchanger itself was approximately 30 seconds. In other words the juice was heated very rapidly from room temperature to the desired processing temperature and held at this temperature only long enough to pass through the heat exchanger. All samples were cooled immediately and examined after one hour and after 48 hours at room temperature, for residual pectic enzyme activity as described below.

Preparation of synthetic and modified natural orange juice. In order to study the effect of peel oil or pulp on deterioration of orange juice quality, samples were prepared in the following manner:

A sample of fresh juice was divided into 4 aliquots. One portion was passed through the 0.020 inch screen of a finisher, heated to 190° F., filled into fruit enamel No. 1 cans, closed, sealed, and cooled. A second portion was processed in the same fashion but not filtered. The remaining two juice aliquots were combined and concentrated for 15 minutes in a pilot plant Mojonnier evaporator to remove the volatile flavors. The concentrated juice was reconstituted with distilled water. Half of this treated juice was filtered through the 0.020 inch screen, heated to 190° F., filled in cans, closed, and cooled, while the remaining portion was processed in the same fashion but without filtering.

The distillate obtained during the concentration of the juice was used as the base to make imitation juice. This imitation juice contained: 8.0% sucrose, 1.0% citric acid, 0.7% potassium citrate, 0.05 mg. ascorbic acid per gram solution per degree Brix, and the remainder distillate. To one half of the imitation juice 5% by volume of orange juice pulp was added. Both portions were then processed and canned as described above.

A completely synthetic orange juice was made having the following composition: 8.0% sucrose, 1.0% citric acid, 0.7% potassium citrate, 0.03% (by volume) cold pressed oil of orange and the remainder water. This mixture was divided into 3 aliquots. To one aliquot 0.05 mg. ascorbic acid per gram solution per degree Brix was added. To the second aliquot both ascorbic acid, in prescribed amount, and 5% pulp from freshly squeezed orange juice were added. Nothing was added to the last portion. All samples were processed at 190° F., filled into cans, sealed, and cooled. These samples were then stored at 0° and 100° F., and were organoleptically examined initially and after 1, 2, 4, 6, 10, and 20 weeks.

Light effect. The effect of exposing orange juice to light during storage was investigated at 2 temperatures. Unfiltered fresh juice was processed at 210° F. in the heat exchanger, filled into Saran bags, sealed, and cooled. One lot of bags was stored at 36° and another at 85° F. At each temperature half the samples were subjected to 40 foot-candles of light from an incandescent light bulb, while the control samples were covered with aluminum foil and placed in a cardboard box to shield them from light. Samples were tasted initially and after 4, 8, and 12 weeks of storage. At each test period samples were also assayed for vitamin C content. The same experiment was repeated with 200 p.p.m. of sulfur dioxide, as $NaHSO_3$, added to the juice before processing.

Enzyme activity. Pectinesterase enzyme activity was evaluated by noting the increase in acidity of the sample due to enzymatic hydrolysis of methyl ester groups of the pectin molecule. The enzyme activity was determined, using the test procedure outlined by Kew and Veldhuis *(10)*.

Organoleptic evaluation. Four separate booths, with simulated daylight illumination, were used. Samples were distributed in random order within the booths. Each taster was asked to score the samples, using grades from 9 to 1, where 9 is the best possible score, 1 the worst, and 5 is borderline but still acceptable. A reference sample of freshly reconstituted frozen concentrated orange juice was graded and placed in each booth. For the synthetic juice a rated sample of Cool-Aid was used for reference. The taste panel consisted of ten members.

RESULTS AND DISCUSSION

Processing procedure. The effect of 2 processing times, 2 temperatures and the addition of 3 preservatives were studied. Samples containing sorbic acid and sodium benzoate had a very objectionable off-flavor after a few weeks storage. Sulfur dioxide, on the other hand, noticeably prevented color deterioration of the juice without producing any apparent off-flavor. There was no noticeable difference between samples processed at 160° for 10 minutes or 190° F. without holding time. Total plate counts made on these samples indicated absence of microorganisms. On the basis of these results it was decided to eliminate sorbic acid and sodium benzoate from further study.

Table 1 summarizes the results of the tests to determine optimum processing temperatures for single strength and concentrated juice. Forty-eight hours after processing there was still slight enzyme activity in four-fold juice processed at 215° F., and in single strength juice which had been processed at 200° F.

TABLE 1

Pectinesterase activity of orange juice and orange juice concentrate heat processed at several temperatures for 30 seconds

Juice strength	Processing temp. ° F.	Enzyme activity after 1 hr.	48 hrs.
4 Fold	200	+++	+++
4 Fold	210	–	++
4 Fold	215	–	+
4 Fold	220	–	–
4 Fold	230	–	–
Single	190	+++	+++
Single	200	–	+
Single	205	–	–
Single	210	–	–
Single	220	–	–

+++ strong activity.
++ medium activity.
+ slight activity.
– no activity.

On the basis of these results it was decided to use processing temperatures of 210° F. for single strength juice and 220° F. for concentrated juice.

Investigation of causes for the occurrence of off-flavors. Peel oil and orange juice pulp were investigated as causes for off-flavor formation. The method used to evaluate the data from this experiment was analysis of variance. Results were considered significant only at the 99% confidence level.

The data in this experiment were divided into two parts and analyzed separately. One part included all the data on the original and modified orange juice, called "natural juice," while the other part included the data on the synthetic and semi-synthetic imitation juices called "synthetic juice." Table 2 gives the analysis of variance of both parts.

TABLE 2

Analysis of variance

The effects of peel oil, filtration, temperature and storage on color, aroma and flavor of synthetic and natural orange juice

Source of variation		d. f.	Synthetic juice		Natural juice		
			Aroma M.S.	Flavor M.S.	Color M.S.	Aroma M.S.	Flavor M.S.
Peel oil	(P)	1	57.857	60.464	1.946	9.250**	26.143**
Filtration	(F)	1	0.714	0.107	0.214	8.750**	11.714**
	PF	1	7.786**	21.607**	0.946	1.821	1.946
Temperature	(T)	1	59.143**	104.571	243.143	236.607	273.000
	PT	1	0.714	1.393	0.304	0.007	0.001
	FT	1	0.250	2.857	0.643	8.250	5.393
	PFT	1	0.161	2.071	0.016	0.071	0.016
Storage	(S)	6	4.062	5.104	94.461	17.116	21.744
	PS	6	1.080	2.756	1.149**	1.515	0.628
	FS	6	3.274**	2.940	0.170	0.783	1.765
	PFS	6	2.012	0.741	0.208	0.378	0.768**
	TS	6	4.128**	9.696**	71.422**	32.065**	38.503**
	PTS	6	2.664	0.940	0.339	0.357	0.711**
	FTS	6	0.339	1.589	0.315	1.366	0.509**
	PFTS	6	0.351	0.589	0.095	0.634	0.033

** Significant at 99% confidence level.

The analysis of variance of the natural juice showed that there were significant differences in the main effects of peel oil and filtration. The effects of peel oil on aroma and flavor indicated that removal of peel oil reduced these scores. This was interpreted to mean that the peel oil component of natural juice in itself is not a cause for flavor deterioration, but its presence is very important to a good orange juice flavor.

This conclusion is strengthened by the fact that the interaction of peel oil with filtration on the synthetic juice was also significant with aroma and flavor. The sample utilizing as its peel oil or flavor component the volatile portion removed from the natural juice was significantly better than the sample containing cold-pressed peel oil, as shown in Table 3.

TABLE 3

The effect of peel oil source and filtration on the average aroma and flavor scores of synthetic orange juice

Peel oil source	Filtered	Aroma	Flavor
Volatiles from natural juice	yes	6.6	6.4
Volatiles from natural juice	no	6.8	6.8
Cold-pressed Oil	yes	6.2	6.2
Cold-pressed Oil	no	5.9	5.7
Least significant difference (L.S.D.) for 99% confidence level		0.26	0.34

Furthermore, it appears in Table 3 that for synthetic juice containing coldpressed peel oil, the filtered was better than the unfiltered juice.

The other significant interactions in this experiment were those involving temperature (Table 2). These indicated that 0° F. was better than 100° F. in all cases.

On the basis of the results of this experiment it was decided not to remove any volatiles from the juice to be packaged in flexible films, but to pass the juice through a finisher equipped with a 0.020 inch screen in order to remove the coarse pulp.

Effect of light on orange juice. The effect of light on sulfited and unsulfited orange juice packaged in Saran, was investigated over a total of 12 weeks' storage at 36° F. and 85° F. The samples were evaluated four times during this period. At each taste session the samples stored at the two different temperatures were tasted separately, but samples stored under light and dark conditions were included in each set. This evaluation was made by tasting such samples once by themselves and once together with a canned control. The differences in the organoleptic scores and in vitamin C and sulfur dioxide values were analyzed by means of analysis of variance.

There was no effect of light on the quality of orange juice, nor did it interact with any of the other factors studied. Also there was no difference between organoleptic scores when samples were tasted by themselves and when these samples were tasted in presence of the canned control.

Aside from the absence of any effect of light on the orange juice, another observation was made. The juice packaged in Saran developed an off-flavor. Table 4 gives the average off-flavor scores of juice packaged in Saran and stored at three different temperatures. It should be noted that off-flavor scores of juice in Saran pouches stored at 74° F. were slightly lower than those at 36° F. However, score of the Saran-packaged juice stored at 85° F. was considerably lower. This off-flavor was described by the tasters, under remarks, as bitterness. It was known *(5)* that off-flavor may develop on heating a product in Saran. No evidence had been available that off-flavors may develop during storage of products at above room temperature in Saran.

TABLE 4

The effect of storage temperature on the average off-flavor scores of orange juice packaged in Saran

Temperature °F.	No. of samples	Off-Flavor
36	48	7.3
74	48	6.2
85	32	4.9

SUMMARY

A study of the effect of some processing conditions on the stability of heat processed orange juice was made. Addition of several preservatives to orange juice was evaluated. Sorbic acid and sodium benzoate were found to be undesirable additives, while sulfur dioxide was advantageous in preventing juice deterioration. Juice sterilization temperatures were determined by using pectic enzyme activity as an index. The temperatures found desirable were 210° F. for single strength juice and 220° F. for concentrated juice.

The effect of peel oil or pulp in processed juice was studied. Juice quality was determined by organoleptic examination, and the data were analyzed by analysis of variance. It was found that peel oil, naturally present in orange juice, did not cause flavor deterioration. The study of the effect of orange juice pulp on flavor deterioration pointed towards the advantages of filtering the juice.

The effect of light on juice during storage in transparent bags was investigated separately. The statistical analysis of the results from this study showed that there was no effect of light on the quality of orange juice.

Acknowledgment

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Film Packaging of Heat Processed Orange Juice Products[a]

II. Storage Study

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Though plastics in all forms are used extensively as food packaging materials, there is little information available on the effect these materials have on the quality of their contents, or the effect of the food on the packaging material. Previously published work on heat processing of foods in plastic containers was performed in this laboratory *(6, 10, 11)*.

The purpose of this study was to investigate the suitability of several plastic films as containers for thermally processed orange juice and orange juice concentrate. The effect of certain processing variables on the quality of the products was included. Films selected for study were those which have a low moisture vapor and oxygen transmission and are relatively heat stable.

The quality of the juice products packaged in bags made from four different films was evaluated over a twenty-week storage period. Storage temperature and addition of sulfur dioxide to the products were included as variables. Canned products were used as controls in evaluating performance of the films.

According to Thor and Goldman *(12)* the requirements of films for food packaging are that they must be (a) nontoxic, odorless, and tasteless and not impart taste to the product, (b) must prevent gain or loss of water, (c) must permit or prevent the exchange of gases, (d) must show toughness and flexibility under all conditions of use, (e) must have adequate stiffness for economical handling, (f) must be printable, and (g) must present an attractive transparent package.

Specifications on films may be found in a chart entitled "Properties of Packaging Films" in the *Modern Packaging Encyclopedia (9)*. The films in this chart meeting the above requirements were: Mylar, Saran, and cellophane in various forms. Teflon and Trithene are also heat resistant films *(5)*. However, the former film does not lend itself to heat sealing and the latter is very expensive. To complete the list of heat resistant films Tygon and polyvinyl chloride should be mentioned. According to a recent report from Germany *(4)* a new polyvinyl chloride which is tasteless, odorless, and heat resistant at 212° F., has been developed.

Aluminum foil is another flexible film which has gained importance in recent years. According to Chapman and Schag *(1)* and Fultz *(3)* recent developments with this film have brought about increased application. The most desirable application of aluminum foil is as a lamination with paper or plastic films. A lamination of foil with polyethylene is rather inexpensive and offers a flexible film with excellent sealability between the two polyethylene surfaces. Furthermore, aluminum foil is readily adaptable to high speed packaging machines.

Besides the above mentioned films, there are many different laminations of two or more films offering a wide variety of properties. These laminations can generally be developed to meet specific requirements.

MATERIALS AND METHODS

Materials. Four films were used in this study. These were: .002 in. Saran double wound; .003 in. cellophane (MSAT-86)—.002 in. polyethylene; .001 in. Mylar—.002 in. polyethylene; and .001 in. aluminum—.00035 in. polyethylene.

Both single strength and 4-fold concentrated juice were used in this study. Single strength juice was obtained by squeezing fresh Florida oranges. The juice was put through a finisher equipped with a 0.020 in. screen to remove extraneous material and some pulp. After screening, the juice was deaerated at room temperature by subjecting it to 28 in. vacuum for 15 minutes.

For orange juice concentrate an adequate supply of a national brand of frozen concentrate was purchased. For use in this study the concentrate was defrosted, put through the 0.020 in. finisher screen, and deaerated.

Apparatus

Heat Exchanger. In order to flash sterilize the orange juice or concentrate a special heat exchanger was built as described in Part I.

Sealers. Two types of film sealing equipment were used in this study (see Figure 1). The polyethylene laminated films were sealed by applying heat and pressure with a Model RT-V Robot Automatic, Air Operated, Jaw sealer (Pack-Rite Machines). For Saran a Vertrod (New York) Model 9-A Impulse Sealer was used.

Storage study. The effect of 5 different containers on the quality of orange juice and orange juice concentrate stored at 36 and 74° F., was investigated in this study. The containers used (see Figure 2) were made from aluminum-polyethylene, Saran, Mylar-polyethylene, cellophane-polyethylene and fruit enamel lined No. 1 cans as controls. The effect of sulfiting the product was also studied.

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Processing procedure. A batch of filtered deaerated single strength juice or concentrate was divided. To one half of the batch 200 p.p.m. sulfur dioxide as sodium sulfite was added. The juice was then processed in the heat exchanger at 210° F., for single strength juice, and 220° F. in the case of concentrate, filled, sealed, and immediately cooled in tap water. Packages were then divided for storage at 36° and 74° F. Samples were

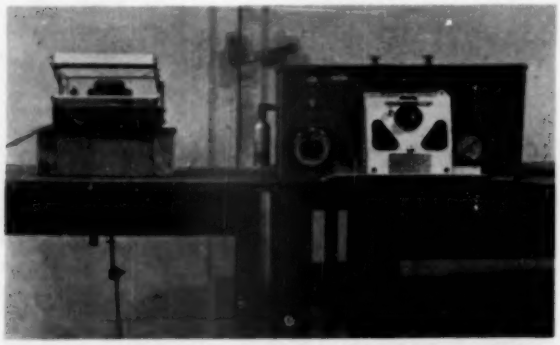

Figure 1. Film sealing equipment. Automatic Sealer (right), and Thermal Impulse Sealer (left).

examined initially and after 4, 12 and 20 weeks in storage. This experiment was replicated 3 times. The following quality evaluation tests were performed at each test period: (a) organoleptic, (b) soluble solids, (c) pH and titratable acidity, and (d) Vitamin C.

In addition weight loss of each bag was obtained as well as relative strength of the films.

In summary this study involved: 2 products, 5 containers, 2 treatments, 2 storage temperatures, 4 storage periods, and 3 replicates. This resulted in a total of 480 samples.

The loss of free sulfur dioxide on storage was investigated in a separate experiment using single strength juice packed in Aluminum-polyethylene and Saran bags, and also in cans stored at 36 and 74° F. Sulfur dioxide determinations were made initially and after four, eight, twelve, sixteen and twenty weeks.

Analytical procedures

Organoleptic. A set of 20 samples, representing one complete replicate of one of the products, was examined in each taste session. There were six such sessions for each storage period. The 20 samples were divided into 4 groups of 5 samples each. Each group contained all the 5 different containers which had received identical processing and storage treatments. Four separate taste booths, with simulated daylight illumination, were used. Samples were distributed in random order within the booths, and groups were distributed at random among the booths. Each taster was asked to score the samples, using grades from 9 to 1, where 9 is the best possible score and 1 the worst, and 5 is borderline but still acceptable. The taste panel of 10 members was instructed to score all samples on flavor, color, aroma, and off-flavor. The flavor rating was to be an evaluation of the characteristic flavor of the product, while the off-flavor rating was to indicate the extent of definite foreign or off-flavors such as sulfite or metallic flavor. A high off-flavor score would indicate lack of any off-flavors. A rated reference sample of freshly reconstituted frozen concentrated orange juice was placed in each booth. The reference sample was prepared from commercial concentrate of the same lot used in the processing study.

Vitamin C. Ascorbic acid was determined chemically by the 2,6 dichlorophenol-indophenol reduction method *(8)*.

Sulfur Dioxide. Free sulfur dioxide was determined by a method described by Downer *(2)* using an electrometric indicator for end point detection as described by Ingram *(7)*.

Acidity, pH and Soluble Solids. The acidity of juice was measured as percent anhydrous citric acid, by titration with standard sodium hydroxide solution. The pH of an undiluted sample was determined with a glass electrode. Soluble solids content was measured with a Bausch and Lomb Abbe Refractometer.

RESULTS AND DISCUSSION

This study included 5 factors related to the quality of heat-processed single-strength and concentrated orange juice which were replicated 3 times. These factors were: single strength vs. concentrated juice; 2 sulfite levels; 2 storage temperatures; 4 storage periods; and 5 containers.

The statistical method employed to evaluate the data and to find the effect of the various factors on the quality of the products was analysis of variance (Table 1). Results were not considered statistically significant below the 99% confidence level.

An important main effect found to be significant was that of sulfite on the preservation of color and flavor of orange juice (see Table 1). In addition, the effect of sulfite on vitamin C retention approached significance. This indicated that the addition of 200 p.p.m. sulfite was advantageous in preserving good color and flavor and perhaps was beneficial in the prevention of vitamin C loss. The lack of statistical significance of sulfite treatment with off-flavor indicated that no objectionable flavor was produced by this small amount of added sulfur dioxide. The average off-flavor scores of sulfited juice were also significantly better than those of unsulfited juice,

Figure 2. Containers used for orange juice in storage study:

I. Packages with juice concentrate

II. Packages with single strength juice

1. Mylar-polyethylene
2. Cellophane-polyethylene
3. Saran
4. Aluminum-polyethylene
5. No. 1 can

except in the case of the canned product. This reversal of scores for the canned product will be explained later.

The significant effect of juice concentration on vitamin C content can be explained by the fact that the 2 products, i.e. single strength and concentrate, were

TABLE 1

Analysis of variance of the effects of five factors on nine quality variables of orange juice and orange juice concentrate in flexible film packages

Source of variation	d. f.	Color M.S.	Aroma M.S.	Flavor M.S.	Off-Flavor M.S.	Sol. Solids M.S.	pH M.S.	Acidity M.S.	Vitamin C M.S.	Weight Loss M.S. x 10^2
Concentration (C)	1	66.3	0.2	44.4	5.2	7481	3619	358176	1954519	152
Replication (in conc.)	4	11.8	3.1	13.8	13.3	2246	239	152928	77544	3205
Sulfite (S)	1	713.0**	112.2	157.0**	53.8	1200	367	30944	395164	386
CS	1	117.8	52.5	14.7	2.9	698	373	75400	16597	665
Error I	4	7.4	2.8	3.3	1.0	2228	109	133708**	21031	1253
Temperature (T)	1	1666.2	1855.1	1663.8	1945.6	458	1526	27120	195940	1014687
ST	1	174.8	15.6	15.6	19.7	3	23	1178	16006	577
CT	1	51.7	2.8	0.1	1.7	420**	952	18876**	86424	4475
CST	1	58.5	44.4	34.0**	34.3	9	4	3	84266**	2169
Error II	8	1.4	1.3	1.8	2.7	4	156	123	425	717
Storage Period (P)	3	1681.2	2269.1**	1864.7	2164.8	999	3379	3498	608682	218375
CP	3	73.4	13.4	16.8	27.6	544**	999**	8784**	18401	661
SP	3	89.4	5.6	1.9	5.9	69	4	2584	27954	171
CSP	3	6.5	8.7	16.4**	22.6	57	30	4491	45912**	433
TP	3	233.9**	319.2	287.7**	334.9	60	651**	3022	16472	115913
CTP	3	18.8	1.4	0.8	0.4	68	396	2620	20672**	191
STP	3	24.9	5.5	7.8	13.8	12	25	904	45745**	319
CSTP	3	11.6	16.5**	5.9	5.7	6	35	1441	18104	822
Error III	48	4.1	3.2**	2.9	3.8**	32	984**	2033	4574**	816
Films (F)	4	885.6	230.1	266.6	230.9	452**	21	19241	828316	555415
CF	4	139.5	35.7	16.4	11.7	157	40	15510**	36765	666
SF	4	50.3	91.7	74.4	100.1**	56	2	2903	19738	542
CSF	4	25.8	18.4**	12.2	18.1	75	31	2298	12786	1281
TF	4	315.3	60.8	64.9	48.7**	23	6	821	24720	338862
CTF	4	20.3	3.5	3.5	6.1	22	36	3054	2059	393
STF	4	3.8	2.0	0.9	1.7	10	16	2956	15158	592
CSTF	4	33.9**	3.8	3.1	2.1	4	1	328	7770	1961
PF	12	169.4**	49.1	59.6**	54.8**	23	31	3037	91940**	67024
CPF	12	45.1	11.9**	10.4	11.8	16	20	2025	16322	1139
SPF	12	8.7	17.0**	9.0**	14.7	36	18	2178	9527	346
CSPF	12	5.9	3.2	3.5	5.3**	32	22	1670	10578	838
TPF	12	60.8	14.8**	18.1	17.1	26	12	1443	7997	40093**
CTPF	12	18.0**	5.1	5.5**	6.6**	27	40	327	6558	1547**
STPF	12	18.9**	3.9	3.2	2.9	20	18	544	4901	773
CSTPF	12	6.4	3.2	0.9	2.6	19	21	2116	7818**	500
Error IV	256	3.5	1.5	1.7	1.8	22	19	1688	7416	686

** Significant at 99% confidence level.

actually two entirely different products. Therefore, it was not surprising to find that they had a significantly different vitamin C content. Likewise, a significant difference in acidity, soluble solids and pH was found.

There was a significant deterioration of aroma with time which was unrelated to packaging material. On the other hand color, flavor, off-flavor and vitamin C were significantly affected by the combination of storage period and type of container (Table 2). This table indicates that after one month of storage there was a significant color difference between the juice in cellophane-polyethylene and that in the other packages except Mylar-polyethylene. The vitamin C content of the juice in cellophane-polyethylene or Mylar-polyethylene also was significantly lower than that of the juice in the other packages.

After 3 months' storage, the color, flavor, and off-flavor scores and vitamin C content of the juice in cellophane-polyethylene and Mylar-polyethylene packages were significantly lower than those of the juice in the other packages, but the organoleptic scores at this time still indicated acceptability (score 5 or above).

After 5 months' storage (Table 2), the juice in Mylar-polyethylene and cellophane-polyethylene was unacceptable from the standpoint of color, flavor, and off-flavor. Also, the vitamin C content was greatly depleted. On the other hand, samples packaged in Saran and aluminum-polyethylene maintained very good color; there was no statistically significant difference between these samples and the canned products as far as color, flavor, off-flavor and vitamin C content were concerned.

TABLE 2

The effect of type of container and storage period on average color, flavor and off-flavor scores and vitamin C content of orange juice

Storage months	Type of container	Color	Flavor	Off-Flavor	Vit. C. mg./100 ml.
None	Mylar-poly	8.6	7.8	7.8	34.9
None	Cello-poly	7.6	7.8	7.8	34.4
None	Saran	8.6	7.7	7.7	35.7
None	Al-poly	8.5	7.8	7.7	35.2
None	Can	8.5	7.8	7.8	36.4
One	Mylar-poly	7.4	7.0	7.1	20.2
One	Cello-poly	6.6	6.6	6.8	12.9
One	Saran	8.2	7.3	7.4	32.5
One	Al-poly	8.2	7.4	7.6	29.7
One	Can	8.2	6.9	6.9	33.1
Three	Mylar-poly	5.4	5.2	5.2	11.2
Three	Cello-poly	5.1	5.0	4.8	6.1
Three	Saran	7.7	6.4	6.3	33.8
Three	Al-poly	7.7	6.8	6.8	31.7
Three	Can	7.7	6.3	6.0	35.2
Five	Mylar-poly	4.0	3.9	3.8	5.2
Five	Cello-poly	3.6	3.7	3.6	2.6
Five	Saran	7.4	5.7	5.3	28.4
Five	Al-poly	6.9	5.9	5.8	26.4
Five	Can	7.3	5.5	5.2	31.7
L.S.D. for 99% confidence..		1.45	1.37	1.57	5.23

The interaction of temperature and containers (Table 3) tells about the undesirable effects of the higher storage temperature on flavor and off-flavor, and in addition gives some information on the performance of the different films. At 36° F., Saran and aluminum-polyethylene were significantly better than

Mylar-polyethylene and cellophane-polyethylene Also, the juice in the former films appeared to possess a higher flavor and off-flavor score than that from the can at 36° F.

At 74° F. storage (Table 3), Mylar-polyethylene and cellophane-polyethylene again proved inferior to the other films. Juice packaged in aluminum-polyethylene received the best flavor and off-flavor scores at this temperature. The reduced score of the canned juice can be explained by the lower scores of sulfited canned juice which are included in these averages. The values for Saran were probably lowered by the development of a bitter off-flavor noted in the juice at this temperature. This was further demonstrated during the light experiment described in Part I.

TABLE 3

The effect of temperature and type of container on the average flavor and off-flavor scores of orange juice

Type of container	Flavor 36° F.	Flavor 74° F.	Off-Flavor 36° F.	Off-Flavor 74° F.
Mylar-poly	6.8	5.2	6.8	5.2
Cello-poly	6.7	4.9	6.7	4.9
Saran	7.3	6.2	7.3	6.0
Al-poly	7.3	6.7	7.4	6.6
Can	7.0	6.2	6.9	6.0
L.S.D. for 99% confidence	0.46	0.46	0.51	0.51

The off-flavor formation in canned sulfited juice is further demonstrated in Table 4. The off-flavor score of this juice (6.0) was significantly less acceptable than the score of the canned unsulfited juice (6.9). This table also portrays once more the advantages of sulfited juice over unsulfited juice for flexible film pouches, especially in the case of the more permeable Mylar-polyethylene and cellophane-polyethylene films. There was no significant difference between Saran and Aluminum-polyethylene pouches.

TABLE 4

The effect of sulfite and type of container on the average off-flavor scores of orange juice

Type of container	Off-Flavor No SO_2	Off-Flavor 200 p.p.m. SO_2
Mylar-poly	5.7	6.3
Cello-poly	5.5	6.1
Saran	6.5	6.8
Al-poly	6.8	7.2
Can	6.9	6.0
L.S.D. for 99% confidence	0.45	0.45

There were significant interactions of containers with sulfite storage period, temperature and juice strength in aroma and flavor. It should be remembered that the most important single factors contributing to these significant interactions are sulfite, storage temperature and storage time.

The combined effect of juice strength, sulfite and container on aroma and flavor scores is given in Table 5. The differences in the scores in this table conform to the previous conclusion that sulfited juice is significantly better than unsulfited juice except in the case of the canned control, which was considerably worse. In the case of Mylar-polyethylene and cellophane-polyethylene pouches, the effect of concentration on aroma and flavor was of importance, and concentrated juice was better. This effect was of no importance in the other pouches. The best combination of factors in this interaction was concentrated, sulfited juice in aluminum-polyethylene. Although this combination was significantly better than any canned product, it was not significantly better than some of the sulfited concentrated and single strength juice packaged in Saran or aluminum-polyethylene.

The combined effect of temperature, storage period and package (Table 6) illustrates again the significant difference between quality of juices stored at 36° F. and at room temperature (74° F.), as well as the effect of storage time on quality. The aroma scores of Mylar-polyethylene and cellophane-polyethylene films were significantly different from those of Saran, aluminum-polyethylene and cans. The latter packages were better, and at 36° F. there was no difference among them in aroma. However, after 5 months'

TABLE 5

The effect of the combination of juice strength, sulfite and type of container on the average aroma and flavor scores of orange juice

Type of container	Aroma: Single strength, No SO_2	Aroma: Single strength, 200 p.p.m. SO_2	Aroma: Four fold, No SO_2	Aroma: Four fold, 200 p.p.m. SO_2	Flavor: Single strength, No SO_2	Flavor: Single strength, 200 p.p.m. SO_2	Flavor: Four fold, No SO_2	Flavor: Four fold, 200 p.p.m. SO_2
Mylar-poly	5.4	6.6	5.7	6.0	5.6	6.7	5.6	6.0
Cello-poly	5.5	6.7	5.4	5.6	5.5	6.6	5.3	5.7
Saran	6.6	7.0	6.7	7.0	6.7	7.0	6.5	7.0
Al-poly	6.5	7.0	6.9	7.2	6.7	7.2	6.8	7.2
Can	6.6	5.8	6.9	6.3	7.0	6.3	6.8	6.4
L.S.D. for 99% confidence	0.29	0.29	0.29	0.29	0.31	0.31	0.31	0.31

TABLE 6

The effect of the combination of temperature, storage period and type of container on the average aroma scores of orange juice and on the weight loss of the container

Type of container	Storage months	Aroma 36° F.	Aroma 74° F.	Weight loss (mg./100 cm²/month) 36° F.	Weight loss (mg./100 cm²/month) 74° F.
Mylar-poly	none	8.6	8.6		
Cello-poly	none	8.6	8.6		
Saran	none	8.6	8.6		
Al-poly	none	8.5	8.6		
Can	none	8.5	8.5		
Mylar-poly	one	8.3	6.5	509.6	2961.7
Cello-poly	one	8.2	5.1	868.9	4361.0
Saran	one	8.3	8.0	171.0	414.5
Al-poly	one	8.3	8.0	52.9	131.6
Can	one	8.3	8.0		
Mylar-poly	three	7.6	3.1	267.9	2632.0
Cello-poly	three	7.5	2.8	425.0	3171.5
Saran	three	7.9	7.6	117.1	412.9
Al-poly	three	7.9	7.5	102.5	139.3
Can	three	7.9	7.6		
Mylar-poly	five	5.5	2.5	262.6	3088.9
Cello-poly	five	4.8	2.5	362.8	4080.8
Saran	five	7.9	7.0	162.1	287.1
Al-poly	five	7.5	6.3	11.4	22.8
Can	five	7.5	7.1		
L.S.D. for 99% confidence		0.41	0.41	489.4	489.4

storage at 74° F., the aroma of the juice which was packaged in aluminum-polyethylene was not as good as that of the juice packaged in Saran and cans.

The combined effect of temperature, storage period and type of container also showed significant differences in the weight loss of the films (Table 6). The total weight of the pouches was approximately 200 g. for those containing single strength, and approximately 55 g. for those containing concentrate products. The weight loss of the pouches was significantly greater at 74° than at 36° F. At both temperatures, the weight loss was greatest in the cellophane-polyethylene bags, followed in order by Mylar-polyethylene, Saran and aluminum-polyethylene. However, only at 74° F. were there significant differences between the films, using the three and five months figures.

Several other significant interactions in Table 1 are not discussed here because they would only emphasize the above results.

Sulfur dioxide loss on storage. The effect of 2 temperatures and 3 containers on the sulfur dioxide losses during storage was studied. The results of this study are summarized in Table 7 and graphically presented

TABLE 7

The effect of type of container, storage temperature and time on the sulfur dioxide content of single strength orange juice

Type of container	Temp. ° F.	Time of storage in weeks					
		none	four	eight	twelve	sixteen	twenty
		Sulfur dioxide concentration in p.p.m.					
Saran	36	127	124	122	120	120	120
Saran	74	127	118	105	95	90	84
Al-poly	36	127	115	112	118	113	96
Al-poly	74	127	113	102	92	65	66
Can	36	122	99	105	92	88	64
Can	74	122	88	20	2	2	2

in Figure 3. These data indicate that sulfur dioxide losses are affected by temperature and film. Even at 74° F. juice in Saran pouches retained most of its original sulfur dioxide content after twenty weeks of storage. The juice in the aluminum-polyethylene pouches lost about half its sulfur dioxide in 20 weeks at 74° F.

The canned product was practically depleted of sulfur dioxide after only 12 weeks' storage at 74° F. (Table 7). Cans which had contained sulfited juice were examined and their enamel lining and body were found to be severely attacked. The enamel coating of these cans was partially removed and enamel flakes were found in the product. Corrosion of the metal was also noted. Apparently sulfur dioxide had reacted with the can body and its enamel lining. These observations also probably explain the flavor deterioration of canned sulfited juice as found in the main storage study (Table 4).

SUMMARY

A study of the suitability of flexible films as containers for heat processed orange juice and orange juice concentrate was made. The quality of orange juice products packaged in four different films was evaluated over a twenty-week storage period. Storage temperature and addition of sulfur dioxide were included as variables. Canned juice products were used as controls. Juice quality was determined by organoleptic examinations and several objective tests. The data from these studies were analyzed by analysis

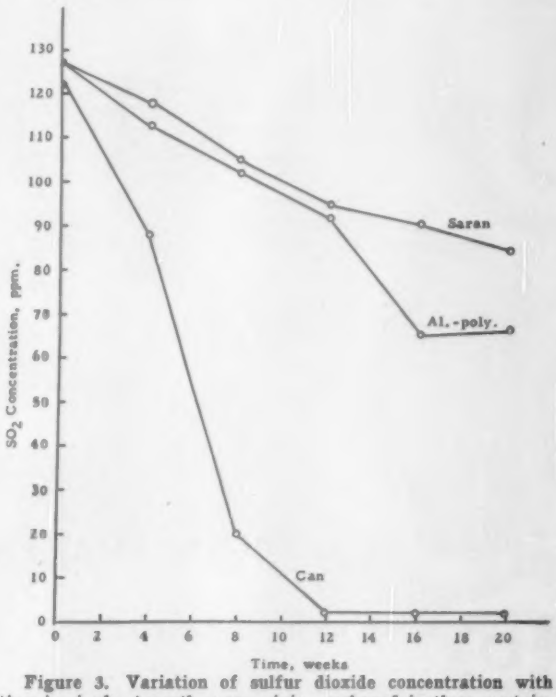

Figure 3. Variation of sulfur dioxide concentration with time in single strength orange juice packaged in three containers and stored at 74° F.

of variance. It was found that the addition of 200 p.p.m. sulfur dioxide to orange juice and storage at low temperature (36° F.) greatly retarded deterioration of the products. Juice packaged in Saran and aluminum-polyethylene pouches was acceptable after five months storage. There was no difference in performance between these packages and cans, except that objectionable off-flavors were noticed in canned sulfited juice and in Saran packaged juice when stored at elevated temperatures. Saran and aluminum-polyethylene pouches were significantly better than Mylar-polyethylene and cellophane-polyethylene in this study. Concentrated juice generally maintained better quality than single strength juice. The difference in weight loss between pouches was significant. Cellophane-polyethylene lost most weight followed in order by Mylar-polyethylene, Saran and aluminum-polyethylene.

It was concluded that it is feasible to package heat processed orange juice, or preferably orange juice concentrate, in pouches made from aluminum-polyethylene or Saran. The juice in these pouches should maintain a quality comparable to that in cans during storage for at least five months at 36° F. If 200 p.p.m.

sulfur dioxide are added to juice packaged in aluminum-polyethylene or Saran it can be held at temperatures up to 74°F. for five months.

Acknowledgment

The authors wish to thank Dr. Horace W. Norton, Professor of Statistical Design and Analysis, for his counsel in the experimental design of this study and in the statistical analysis of the data.

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Antibiotics in Poultry Meat Preservation:

A Comparison of the Tetracyclines

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Most of the poultry marketed in this country through commercial channels is handled as a chilled (unfrozen) product. Such poultry is commonly processed as an eviscerated whole carcass (giblets being placed in the body cavity). After ice-slush chilling to an internal temperature below 2.2° C. (36° F.) the birds are drained and ice-packed in wire-bound shipping containers. These are distributed to the retail market by refrigerated truck. Here the poultry is usually kept in a walk-in cooler until a day or two before retail sale. The birds are then removed from the ice, cut-up, placed in a molded composition tray and over-wrapped in transparent film. Ordinarily they are then placed in a refrigerated [0°–10° C. (32°–50° F.)] self-service display case for retail sale.

Some chilled poultry is cut-up and packaged in the processing plant. Even with the obvious advantages of lower labor cost and greater convenience for the retailer, this alternate method of handling is not common. Reasons given include: greater overall cost, poorer shelf life, and excessive "drip" and weight loss.

As may be surmised, there are serious shelf-life problems in the distribution and marketing of chilled poultry. A number of studies have shown that improvements in shelf life may be achieved through good plant sanitation, including in-plant chlorination, prompt chilling, and low holding temperatures *(3, 4, 6)*. More recently it has also been demonstrated that antibiotics, in conjunction with the above practices, may be useful in improving shelflife *(1, 2, 5, 7)*. Currently both chlortetracycline (CTC) and oxytetracycline (OTC) are permitted by the Food and Drug Administration for the preservation of poultry meat. Tetracycline (TC) has not yet been approved.

[a] Employed jointly by the Biological Sciences Branch, Agricultural Marketing Service and University of California. This work was financed, in part, under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

Trials reported herein were initiated to obtain further information about the relative effectiveness of the tetracycline antibiotics in extending the shelf life of chilled poultry. It was of particular interest to investigate their use under commercial conditions and over an extended period of time.

PROCEDURE

All trials were made in a large modern poultry processing plant located in Turlock, California. This plant handles both chickens and turkeys; however, only chicken fryers were used in the studies reported herein. Plant sanitation and inspection for wholesomeness in this plant are under USDA supervision.

In general, the trials consisted of comparing the shelf-life of fryers which had been chilled in ice-slush containing: (1) no antibiotic, (2) chlortetracycline, (3) oxytetracycline, and (4) tetracycline. Each antibiotic was used at 20 p.p.m. Lots were prepared as follows: Eviscerated birds were selected as they were being removed from the shackles at the end of the conveyor line. The birds were placed in four, thoroughly cleaned chill tanks containing ice-slush (plus antibiotic where indicated). Two hundred birds in a single chill tank constituted an experimental lot.

The birds were chilled in the ice slush for 2 hours; compressed air was used to secure good agitation. They were then removed and placed on the draining and cut-up conveyor line. Whole bird samples from each treatment were obtained at this point. These were placed in polyethylene bags and ice-packed in wirebound boxes.

Cutting-up in this plant was accomplished by the use of a meat-cutting band saw. The parts of each bird were assembled in a molded fiberboard tray and overwrapped with polyethylene or Pliofilm in accordance with usual practice in this plant. Samples from each treatment were selected after tray packing and overwrapping and then ice packed in wire-bound boxes. These plus the whole bird samples referred to above were transported to Davis by car.

On arrival at Davis the birds from each treatment were divided into 2 sub-lots: (a) One consisting of birds which were first removed from the ice, then stored in air in a cooler at 7.2° C. (45° F.) (experimental lot), and (b) the other consisting of birds which were first removed from the wire-bound box, then repacked in ice and stored in the same room (control lot). Birds in the second lot served as controls in the sensory evaluation tests. It had previously been shown that such ice packed birds retained their fresh odor for the duration of the storage periods that were contemplated and used.

Samples were taken from the storage room at predetermined intervals, based on results of preliminary trials which demonstrated how long the birds could be held before noticeable odor changes were apparent. (See Results for bacteriological and sensory evaluation.) After removing the polyethylene wrap, a square inch of thigh surface was scrubbed with a sterile calcium alginate swab. Earlier trials had established that skin counts were quite uniform from piece to piece for birds within a lot. This swab was then placed in a tube containing 1% Calgon solution. The swab and solution were thoroughly shaken, diluted, if necessary, and plated in duplicate, using Eugonagar (Baltimore Biological Laboratory). The plates were incubated for 7–8 days at 7.2° C. (45° F.) and then examined for colonies. Where possible, plates containing 30–300 colonies were used to estimate counts.

After the swab had been taken from the bird, the carcass, if still whole, was cut up. Several pieces of each bird (leg, thigh and wing) were then placed in a clean, glass covered quart Mason jar. These were presented, one at a time, to a trained and experienced panel of 6–14 judges. Not all judges were available for all sessions. Samples from the different treatments and their corresponding controls were presented in random order, so that the judges had no knowledge of the identity of the samples. Thus, in each case, each judge evaluated samples stored at 7.2° C. (45° F.) (experimental) and samples from the same treatment stored in ice (control). A known sample, from birds stored in ice, was available to the panel at the beginning of each session so as to permit orientation to fresh chicken odor.

Panel members were instructed to declare samples "off" when any foreign odor was detected. Such odors were commonly described as "dirty-dish-rag", sour, mayonnaise-like, sweetish-putrid, all characteristics of spoiling poultry.

Data were analyzed using the Chi Square test. The pooled judgments (off or OK) for the experimental birds were compared to those for all controls used in the particular treatment. The birds were judged as "off-odor" when calculated values indicated significance at the 1% level or better. See Table 1 for an example.

TABLE 1

Sample sensory panel evaluation chart [1] (Trial 1—no antibiotic)

Storage time at 45° F.	Experimental sample [2]			Control sample [3]			X^2 [4]
	Off	OK	Total	Off	OK	Total	
3 days	8	19	27	3	24	27	3.65
4	8	24	32	2	14	16	2.12
5	21	19	40	5	25	30	26.5
6	16	4	20	5	35	40	>36
7	32	4	36	3	24	27	>30
		Totals		18	122		

[1] Figures represent number of judgments in each category.
[2] Birds stored in air at 45° F.
[3] Birds stored in ice.
[4] Values over 6.63 significant at 1% level.

RESULTS AND DISCUSSION

A considerable number of storage life trials were run from April through October, 1956. Only the results of those trials for which the most complete data were obtained are presented here. About 10 days after these trials began, the Acronize [b] process came into regular use in the processing plant. This may have affected the results obtained. However, no evidence is available to support this supposition.

Results of the sensory evaluation tests are given in Figure 1. Oxytetracycline extended the storage life

[b] A trade mark for poultry chilled in ice slush containing CTC.

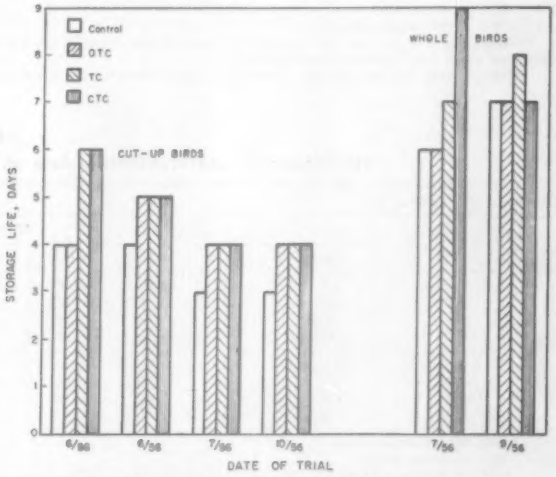

Figure 1. Effects of tetracycline antibiotics on shelf-life of chicken fryers stored at 7.2° C. (45° F.) as indicated by sensory tests.

in 3 trials out of 6; in the other 3 trials it was equal to the untreated lot. Chlortetracycline gave an extension of storage life in 5 trials; in the other trial it was equal to the untreated lot. Tetracycline extended storage life in all of 6 trials.

Antibiotic treatment gave a day or two additional shelf life to cut-up birds and about 1–3 days more shelf life to whole birds. TC provided the best overall performance; however, the variability in results was too high to permit differentiating among the three antibiotics.

There is a noticeable difference in storage life between cut-up and whole birds in favor of the latter. Other studies by the present authors have shown that initial surface counts are very much lower on whole birds than on those cut-up. In addition, the cutting operation exposes cut tissue surfaces which are more susceptible to bacterial invasion. These facts probably account for the difference in shelf life.

Tables 2 and 3 present the combined bacteriological and sensory evaluation data for the six trials. Figure 2 shows the changes in average bacterial counts during storage of the cut-up birds. In general, the counts had increased sharply by the time the birds were judged off-odor. However, there are notable exceptions. It may be that sampling and plating errors occurred and/or the medium used did not always support good growth of the predominant organism.

In certain cases counts reached high levels without the birds being judged off-odor. In this case it seems reasonable to assume that the predominating organism did not produce objectionable odors. These results suggest that bacterial counts may not always serve as a reliable index of organoleptic condition. It is the authors' opinion that reliable sensory evaluation tests provide the soundest method for measuring this quality factor.

In general, the results reported here are in agreement with those published earlier on the effect of the tetracycline antibiotics on the storage life of chilled poultry. However, it is obvious that the shelf life extension is comparatively small at temperatures as

TABLE 2

Microbiological and organoleptic data on tray packed fryers treated with the tetracyclines

Days at 7.2° C. (45.0° F.)		3		4		5		6		7		8		9		10	
Exp. No.	Treatment[1]	Microbiological and Organoleptic Data															
		Count[2]	Odor[3]	Count	Odor	Count	Odor	Count	Odor	Count	Odor	Count	Odor	Count	Odor	Count	Odor
1	Control	0.019	OK	17	OK	1.7	Off	58	Off	68	Off	....	....	....	....	....	....
	OTC	0.0036	OK	0.02	OK	0.02	Off	0.99	Off	11	Off	160	Off	....	....	....	....
	TC	....	....	....	....	....	....	....	OK	4.3	Off	200	Off	....	....	....	....
	CTC	....	....	....	....	....	....	....	OK	0.71	Off	....	....	4.4	Off	2.9	Off
2	Control	0.0006	OK	0.013	OK	3.5	Off	12	Off	510	Off	....	....	....	....	....	....
	OTC	0.002	OK	0.003	OK	0.12	OK	20	Off	38	Off	....	....	....	....	....	....
	TC	....	....	....	....	0.2	OK	2.9	Off	8.2	Off	300	Off	700	Off	....	....
	CTC	....	....	....	....	....	OK	0.03	Off	1.5	Off	0.36	Off	....	....	....	....
3	Control	....	OK	0.0032	Off	0.57	Off	13	Off	19	Off	....	....	....	....	....	....
	OTC	....	....	0.0002	OK	0.46	Off	6.3	Off	2.5	Off	250	Off	....	....	....	....
	TC	....	....	....	OK	0.033	Off	0.45	Off	4.5	Off	180	Off	....	....	....	....
	CTC	....	....	....	OK	0.0045	Off	0.54	Off	3.8	Off	6.5	Off	....	....	....	....
4	Control	....	OK	1.8	Off	100	Off	380	Off	....	....	....	....	....	....	....	....
	OTC	....	....	4.6	OK	76	Off	180	Off	....	....	....	....	....	....	....	....
	TC	....	....	....	OK	18	Off	550	Off	....	....	....	....	....	....	....	....
	CTC	....	....	....	OK	3.6	Off	9	Off	300	Off	....	....	....	....	....	....

[1] OTC = oxytetracycline.
TC = tetracycline.
CTC = chlortetracycline.

[2] Total count x 10^5 per sq. in. skin surface. Each count is an average of the number of organisms obtained from two fryers, except in a few instances when only one bird was examined.

[3] Off = Birds judged off-odor when Chi Square values significant at 1% level.

TABLE 3

Microbiological and organoleptic data on whole-packed fryers treated with tetracyclines

Days at 7.2° C. (45.0° F.)		7		8		9		10		11		12	
Exp. No.	Treatment[1]	Microbiological and Organoleptic Data											
		Count[2]	Odor[3]	Count	Odor	Count	Odor	Count	Odor	Count	Odor	Count	Odor
1	Control	13	Off	390	Off	840	....	....	....	....	....	....	....
	OTC	10	Off	2.2	Off	280	Off	310	....	....	....	....	....
	TC	2.9	OK	17	Off	5.6	....	....	....	....	....	....	....
	CTC	0.029	OK	31	OK	2.5	OK	76	Off	720	Off	340	....
2	Control	200	OK	320	Off	320	Off	....	....	....	....	....	....
	OTC	98	OK	660	Off	1600	Off	....	....	....	....	....	....
	TC	6.5	OK	96	OK	510	Off	....	....	....	....	....	....
	CTC	2.1	OK	1.5	Off	2.2	Off	30	Off	18	Off	14	Off

[1] OTC = oxytetracycline.
TC = tetracycline.
CTC = chlortetracycline.

[2] Total count x 10^5 per sq. in. skin surface. Each count is an average of the number of organisms obtained from two fryers, except in a few instances when only one bird was examined.

[3] Off = Birds judged off-odor when Chi Square values significant at 1% level.

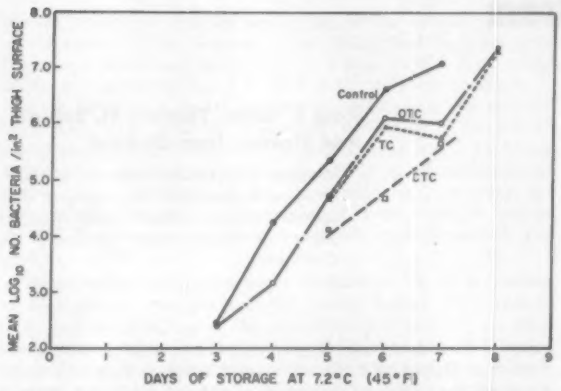

Figure 2. Effect of tetracycline antibiotics on growth of bacteria on cut-up chicken fryers stored at 7.2° C. (45° F.).

high as 7.2° C. (45° F.) and is far less than that reported at lower storage temperatures. From a practical point of view, really effective antibiotic treatment will depend on the concurrent use of low temperatures, the nearer to the freezing point, the better *(6)*, and good sanitation practices.

Whole birds keep very much better than those which are cut-up. Such stock also respond to antibiotic treatment. This suggests that keeping the birds in whole form as long as possible plus tetracycline antibiotic treatments and ice packing should provide better storage life for chilled poultry.

SUMMARY

Comparison was made of the effectiveness of three tetracycline antibiotics for improving the storage life of chilled poultry. Six trials were made under commercial conditions. In four trials the birds were prepared as cut-up, tray packed fryers; in two trials the birds were packaged whole in polyethylene. All birds were stored at 7.2° C. (45° F.). Oxytetracycline treatment increased storage life in three of six trials, chlortetracycline in five trials, and tetracycline in all six trials. Increases in storage life ranged from 0–3 days. Whole birds kept much better than those which had been cut-up.

Acknowledgments

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Low-Moisture Peaches Prepared from Fresh Fruit

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Though drying has long been recognized as a commercially satisfactory method for preservation of fruits, the final product, because of its relatively high moisture content, deteriorates rapidly at the high temperatures often encountered in military operations. The moisture content of ordinary dried fruit is in the range of 15 to 30%. There has been some commercial production of low-moisture fruit prepared by further drying in vacuum of fruit which has been partially dried by conventional methods *(6)*.

Exploratory work has been done in this laboratory on preparation of low-moisture fruit with superior quality and stability. This paper reports studies on preparation of low-moisture freestone peaches directly from fresh fruit and on the effects of pre-drying treatments and packaging conditions on quality after storage.

The most obvious manifestation of deterioration of dried fruits is browning, which may be accompanied by impairment of flavor, texture, and nutritive value. Investigations of others have shown that the rate of browning of dried fruits and vegetables is dependent on moisture content, availability of oxygen, concentration of added sulfur dioxide, and storage temperature *(2, 3, 7, 9, 10, 11, 12)*. Although some products brown faster when the moisture content is decreased in the ordinary moisture range, this trend is apparently reversed with very low moisture. The maximum rate of browning of dried apricots in vacuum has been reported to occur at 5 to 10% moisture *(10)*.

It was surmised that the stability of dried peaches would be best at the lowest attainable moisture level. This was found to be the case in preliminary trials with two typical freestone varieties, Elberta and J. H. Hale, dehydrated in a vacuum shelf drier to less than 2% moisture. A limited storage test at 100° F. with samples having 1.6% and 5.3% moisture showed considerably better stability at the lower moisture level. The products could be reconstituted quickly with good retention of color and flavor. Results were sufficiently promising to warrant the more extensive study at 1% or less moisture described in this report.

MATERIALS AND METHODS

Preparation of the low-moisture product. Ripe Elberta peaches were selected from the delivery line of a local cannery. The fruit was immersed in boiling water for 20 seconds, cooled in cold water, and manually skinned, pitted, and sliced into eighths. To inhibit browning during the processing period, the fruit was dipped in 0.5% citric acid after peeling and again after slicing. Each of 7 lots of the sliced fruit was given a different treatment as described below.

F1, *no supplementary treatment.* F2, *sulfited after drying.* A small test tube containing frozen sulfur dioxide equivalent to 300 p.p.m. of the dried fruit was placed in each sample can just before sealing. F3, *blanched.* The fruit was spread on the drier trays and blanched 5 minutes with steam. The condensate with leached soluble matter, about 10% of the solids of the peaches, was discarded. F4, *starch coated.* The fruit was dipped 10 seconds in a 3% dispersion of cornstarch at not over 180° F., drained about one-half minute, and spread on the drier trays. F5, *sulfited (light).* The fruit was dipped in 0.064% sulfur dioxide solution for 2 minutes, drained 10 minutes, and spread on trays. The sulfur dioxide content (wet basis) was about 30 p.p.m. F6, *sulfited (moderate).* Like Lot 5 except sulfur dioxide concentrations in dip and drained fruit were 0.32% and about 200 p.p.m., respectively. F7, *sulfited and starch coated.* The fruit was first sulfited as for Lot 6 and then starch coated as for Lot 4.

Loaded trays were placed on the shelves of a 60-cu. ft. vacuum shelf drier. Vacuum was applied and the shelves were heated to 190° F. by circulation of hot water. The temperatures of the shelves and the fruit, measured by thermocouples during a typical run, are shown in Figure 1. The fruit temperature never exceeded 140° F. Final pressure in the drying chamber was about 0.5 to 1.0 mm. of mercury and total drying time about 21 hours. This brought the moisture level to less than 1%. It is likely that further research would lead to faster and more uniform drying.

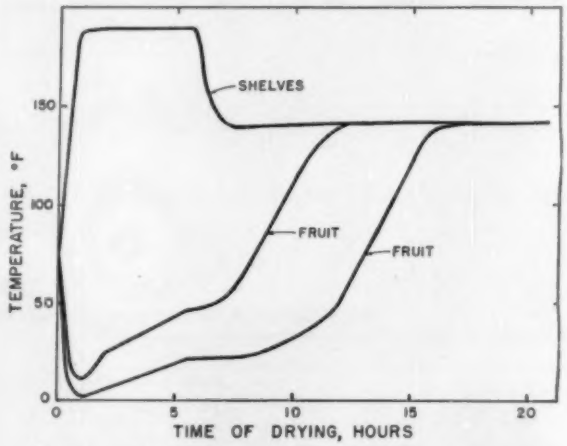

Figure 1. Temperatures of shelves and fruit as measured by thermocouples during a typical run.

Packaging and storage. All samples were sealed in 404 x 700 (46 oz.) cans, beaded for samples packed in vacuum, and with

enamel finish for samples containing sulfur dioxide. Sample size was 90 to 120 g. Removal of the dried fruit from the drier trays and packaging operations were done in the drier room, which was maintained at 5 to 10% R.H. for these purposes.

Four different packs of each lot were made: air and vacuum, each with and without in-package desiccant (IPD) *(13)*. Absolute pressure in the vacuum-packed cans was 3 to 4 mm. of mercury. The desiccant consisted of 10 g. of calcined lime sealed in a stretchable paper (Promset)[6] bag, one bag per sample. The test samples, in duplicate, were stored 6 months at 100° F. Control samples were sulfited, vacuum packed, and kept at −30° F.

Rehydration and organoleptic evaluation. A 50-g. portion of each sample was added to 400 ml. of boiling 20% sucrose sirup and weighted below the surface with a heavy petri dish. For optimum color and texture, the fruit was simmered 1 minute and was then cooled about 2 hours at room temperature. Most of the slices of each portion were cut up, examined, and the number with internal browning was recorded.

Evaluations were made by a panel of 6 judges scoring coded samples in groups of four in comparison with a reference control. A hidden control was sometimes substituted for one of the coded samples. Samples representing the various supplementary treatments were compared and those of best quality were then used to appraise the packaging variables. Groups were not repeated but duplicate samples were tasted in different combinations. A 10-point scale was used for scoring flavor and color with the reference control assigned a score of 8. In addition, the samples were scored for off-flavor, sulfite, and texture by use of short descriptive scales.

Tasting was done in booths under red lights to hide color differences. Color scoring was done on recoded samples placed under artificial "day-light" after completion of flavor scoring.

Analytical measurements. Uncut, reconstituted slices of each sample were placed in a dish having an optically clear, flat bottom. The reddish area near the pit was turned away from the bottom. The color values *(a* and *b)* were determined with a Hunter color and color-difference meter, using the large aperture, after setting the instrument with a Bureau of Standards maize plaque, No. SBC 35, as standard. In order to express the data by a single number for each sample, the red *(a)* and yellow *(b)* values were combined as $(a^2 + b^2)^{1/2}$ which is a measure of color saturation. This choice was based on the assumption that small differences in hue or in total reflectance (R_d) would have little effect on attractiveness to the average consumer, but a decrease in saturation, toward brown or gray, would decrease attractiveness to nearly all consumers.

An uncooked portion of each sample (40 g. or more) was ground to 40-mesh at −10° F. Portions of the powder were used to determine moisture by a vacuum-oven method (30 hrs. at 140° F. and 5 mm. or lower pressure) *(4)*, sulfur dioxide by a volumetric method *(7)*, and "soluble (brown) color." The method used for the "soluble color" was based on procedures described for dehydrated vegetables *(1)* and for dried apricots *(10)*. Twenty grams (dry basis) of the powder was suspended in 200 ml. of 55% (by volume) ethanol, shaken 2 hours by a mechanical shaker and filtered by gravity through a Whatman No. 3 paper. The filtrate was diluted to 5 times its volume with solvent and read in a Klett-Summerson colorimeter using a 20-mm., parallel-sided cuvette and a 440 mμ filter. Soluble color was expressed simply as the colorimeter reading; a high reading thus indicated a high concentration of soluble (brown) color.

RESULTS

Initial Quality

In Tables 1, 2, and 3 the first columns of data contain analytical results obtained either before storage or on control samples held at −30° F. Moisture contents are all in the range from 0.42% to 0.76%. Color saturation data (Table 2) show that the sulfited preparations form a category of relatively high values while the nonsulfited form another of low values. On the other hand, soluble color (Table 3) is *lower* in all members of the sulfited category than in any of the nonsulfited. Data for both color saturation and soluble color, therefore, indicate that the sulfite dip was beneficial in preservation of color during processing.

TABLE 1

Moisture content of 7 low-moisture peach preparations before storage and after 6 months at 100° F. in 4 types of package

Supplementary treatment	Before storage	Vacuum pack[1]		Air pack[1]	
		+IPD[2]	−IPD	+IPD	−IPD
	%	%	%	%	%
None	0.73	0.17	0.77	0.19	0.79
SO_2 in package	0.76	0.21	0.74	0.19	0.70
Blanch	0.48	0.22	0.48	0.15	0.47
Starch coat	0.73	0.30	0.89	0.22	0.77
Light sulfite dip	0.51	0.20	0.60	0.15	0.55
Moderate sulfite dip	0.73	0.21	0.57	0.17	0.58
Sulfite plus starch coat	0.42	0.17	0.45	0.33	0.47

[1] The moisture values presented are averages of 2 samples carried separately through storage and subsequent operations.
[2] IPD means in-package desiccation.

TABLE 2

Hunter color saturation values of 7 low-moisture peach preparations after 6 months at 100° F. in 4 types of package

Supplementary treatment	Control[1]	Vacuum pack		Air pack	
		+IPD	−IPD	+IPD	−IPD
None	28.4	26.8	26.5	25.3	25.6
SO_2 in package	.....	27.3*	28.7*	23.2*	.....
Blanch	27.3	26.6	26.0	24.5*	24.1*
Starch coat	28.5	26.3*	25.5*	23.1*	23.6*
Light sulfite dip	33.4	31.5*	31.0	29.3	28.8
Moderate sulfite dip	34.6	32.0	31.4	28.4	30.0*
Sulfite plus starch coat	33.1	32.8	33.3	28.2	29.3

[1] Values for the controls are means of readings on 2–7 samples. Of the other values, 11 (asterisk) represent a single reading and 16 are averages of 2 readings. The spread between the members of a pair never exceeded 2.7.

Sulfur dioxide levels were less than 100 p.p.m. in Lots F2 and F5, 200 p.p.m. in F6, and 400 p.p.m. in F7. Only one judge on the taste panel was consistently able to detect sulfite in the reconstituted samples of F6 and F7. Three others found it occasionally but not consistently. The taste of sulfite was not strong enough to be generally objectionable. The sulfite-dipped preparations were similar to each other in flavor and color and were as good as, or better than, the nonsulfited.

Most remarkable feature of the reconstituted fruit was its greater resemblance to stewed fresh peaches in texture, flavor, and general appearance than to conventional stewed dried

TABLE 3

Soluble color in 7 low-moisture peach preparations after 6 months at 100° F. in 4 types of package[2]

Supplementary treatment	Control[1]	Vacuum pack		Air pack	
		+IPD	−IPD	+IPD	−IPD
None	44	44	51	46	53
SO_2 in package	41	46	43	43	49
Blanch	41	39	41	38	39
Starch coat	39	45	45	41	47
Light sulfite dip	30	31	33	31	31
Moderate sulfite dip	29	30	30	30	32
Sulfite plus starch coat	31	32	31	31	31

[1] Control samples stored in vacuum at −30° F.
[2] The values given are averages of Klett readings on duplicate samples carried separately through storage. The mean difference in the readings on the 35 pairs of duplicates was 1.1; the largest difference was 7.

[6] Manufactured by Mid-States Gummed Paper Co., Chicago, Ill. Mention of this product does not imply recommendation by the United States Department of Agriculture over others of a similar nature not mentioned.

peaches. Reconstitution was rapid. Pre-soaking and long cooking were not only unnecessary but such procedures impaired surface color and promoted internal browning. The fruit was friable and pleasant to eat in the dry state. The main disadvantage is the low bulk density due to little shrinkage during dehydration. Only about 120 g. representing about 840 g. of fresh fruit (slices), could be packed in a 46-ounce (1360 ml.) can.

Quality After Storage

Organoleptic evaluation. Panel results, interpreted with regard to pronounced differences or close similarities of the scores in flavor and color (Table 4), show that vacuum-packed, sulfited samples (F5 and F6) were superior to any of the nonsulfited. The retention of quality in these sulfited samples is of prime interest; they were not appreciably different from the hidden controls. In contrast, the vacuum-packed nonsulfited samples were poor in flavor and color as demonstrated by their low scores.

TABLE 4

Mean flavor and color scores for vacuum-packed low-moisture peaches

		Hidden control (−30° F.) 4 tastings	Sulfited (100° F.; 6 months) 7 tastings	Nonsulfited (100° F.; 6 months) 10 tastings
Flavor:	Extremes of mean scores	7.7–8.0	5.8[1]–7.5	2.2–5.3
	Overall mean[2] score	7.8	7.1	4.1
Color:	Extremes of mean scores	8.0	6.5–8.3	3.2–6.0
	Overall mean score	8.0	7.2	4.4

[1] The value 5.8 was unusually low; the second lowest score was 7.0.
[2] The "mean score" is the mean of 6 judges' scores in one tasting. The "overall mean" is the mean of all scores in several tastings.

The larger range of scores on the nonsulfited samples in comparison with the sulfited is at least partly due to the diversity of preparations (blanched, starch-coated, untreated) represented in the nonsulfited category. Only flavor and color scores are reported because off-flavor ("hay-" or "tea-like") showed high correlation with flavor (r, −0.96), texture did not vary from that of the controls, and internal brown count, held to a minimum by a short cook, showed little relation to treatment and packaging variables.

With treatment limited to sulfite, variation in scores due to packaging was considered. When vacuum and air packaging were compared in the same taste groups, the overall mean flavor scores in five comparisons were 6.9 for vacuum and 4.1 for air while the respective color scores were 6.9 and 3.6. In two similar comparisons with nonsulfited samples (F1), the same beneficial effect of vacuum packaging was shown. These data show vacuum packaging to be definitely superior to air packaging for preservation of flavor and color during storage.

Other panel results, based on fewer comparisons and therefore not of the same order of reliability as those above, are nevertheless of interest. Vacuum packed, sulfited samples with and without IPD were compared only twice; results were inconclusive. The mean flavor of samples stored with IPD was 7.1; of those without IPD, 6.3; the corresponding color scores were 7.2 and 6.4, respectively. IPD *was* effective, however, in preventing accumulation of transient hay- or varnish-like odors observed on opening the containers of some samples. These odors were stronger in air-packed than in the corresponding vacuum-packed samples. Vacuum-packed samples of Lot F6 (moderate sulfite dip) were the only ones without IPD in which no off odor was detected.

Addition of sulfur dioxide at the time of packaging (F2) resulted in good flavor and color scores only in vacuum pack without IPD. These were also the only samples in which the odor of sulfur dioxide was found on opening the containers. Blanching (F3) resulted in lower flavor scores though somewhat higher color scores than no treatment at all (F1). Starch coating (F4) made no improvement over untreated samples (F1); likewise starch coating in combination with sulfite (F7) was no better than plain sulfite (F6).

Analytical measurements. Complete moisture data for each of the seven lots after storage in the four types of package are shown in Table 1. In samples without IPD, moisture content remained unchanged within the sampling and analytical errors. On the other hand, samples stored with IPD lost half or more of the initial moisture to the desiccant. Since the moisture contents at the time of packaging were only 0.4–0.8%, these results again demonstrate the efficiency of the lime type of IPD in lowering the moisture content of dried foods.

Hunter color saturation values appear in Table 2. These data indicate that vacuum packaging is superior to air for the preservation of color in storage and thus support panel scores. IPD was of no advantage with regard to color; at least not in the moisture range represented by our preparations. It is of interest that change in the color saturation values was no greater in the nonsulfited preparations, F1, F3, and F4, than in the sulfited F5, F6, and F7.

Soluble color (Table 3) of the sulfited preparations shows no change during storage. This is also true of the blanched preparation (F3) in which soluble color was relatively high in the control samples. The other preparations show evidence of browning in storage.

DISCUSSION

Most notable features of the results are the very good flavor and color shown by the vacuum-packed samples of the sulfited preparations (F5, F6 and F7) when reconstituted after 6 months' storage at 100° F. Considering the very low sulfite content of these samples when packed (less than 400 p.p.m.), their retention of the observed high quality can hardly be attributed to sulfite alone. Conventional dried peaches with moisture content of 24% and 900 p.p.m. SO_2 have been found in this laboratory to become very dark brown within 3 months in vacuum-pack at 100° F. Thus, in agreement with our earlier observations, the low moisture content of the present product appears to be the principal factor in its good stability. The sulfite dip was definitely beneficial in preservation of color during the processing that preceded storage. But the fact that changes in color saturation values during storage were no greater in 3 of the nonsulfited preparations than in the 3 sulfited ones indicates that, in the low moisture region, sulfite has little effect on color stability during storage.

Results are inconclusive with regard to any difference in quality between lightly sulfited F5 and moderately sulfited F6 preparations in vacuum packaging. More sensitive taste methods, more severe storage conditions, or adverse packaging might establish differences in quality related to variations in sulfite treatments. This point merits further investigation with regard to low-moisture fruit. As compared to the sulfite dip, the use of SO_2 gas in the package was unsatisfactory not only because of its being rendered ineffective by use of IPD but also because of the faded and mottled appearance of the dry slices.

Though a starch coat inhibits browning in certain vegetables *(5, 14)*, it contributed nothing to the quality of our low-moisture peaches either when used alone or in combination with sulfite.

"Soluble color", expressed as a colorimeter reading at a single wave length, is presumably a measure of dark substances formed in browning reactions. As a measure of darkening in dried apricots, however, a similar method was found to be limited by variations in sulfite content *(10)*. As a general criterion of the color quality of the product, the method proved unsatisfactory in the present study. This is shown by a comparison of the data in Table 3 with the panel scores. Before storage (assuming no change at −30° F.) the soluble color values of the three sulfited preparations were about the same and relatively low. There was no change (browning) in storage, irrespective of the kind of package used. The low panel color scores of the air-packed samples, therefore, were due to changes which are not reflected by soluble color. Oxidative fading of carotenoids would appear to be one such change. In contrast to soluble color, the Hunter color saturation values show color differences between vacuum-packed and air-packed samples, thus reflecting panel scores.

The degree of vacuum used in the present study (absolute pressure of 3–4 mm. Hg.) is higher than that generally used in commercial vacuum packaging. The use of high-purity nitrogen in the container would be more feasible and presumably would give as good stability as obtained with vacuum.

The failure of IPD to show any considerable effect on maintenance of quality is probably due to the very low moisture contents (0.4–0.8%) giving approximate maximum stability at the time of packaging. Notwithstanding these initially low levels the desiccant effectively reduced the moisture contents to less than half. At a somewhat higher initial level, e.g., 1.5–3.0%, at which flavor and color would be more subject to deterioration, it is probable that a definitely beneficial effect of IPD would be shown. Its effectiveness in reducing moisture in the very low range augurs well for its use in modifying the drying procedure. The vacuum shelf drying period might be considerably decreased and the product with a higher moisture content packaged with IPD.

The low bulk density of the product is its most obvious defect. Though unimportant for civilian use, this would be a serious consideration in connection with military requirements for shipping and storage. The density might be increased by preliminary drying at atmospheric pressure to about 50% weight reduction. It should be pointed out, however, that an increase in density brought about by any means may involve the necessity of a longer period of rehydration.

SUMMARY

Seven lots of low-moisture freestone peaches, each representing a different supplementary treatment, were prepared from fresh fruit by drying *in vacuo* to less than 1% moisture. Such fruit is considerably more stable at elevated temperatures than dried peaches with 20% or higher moisture content. The sulfite dipped fruit packed in vacuum showed remarkable quality after storage at 100° F for 6 months.

Though in-package desiccant (IPD) reduced the moisture content to less than half its initial level of 0.8% or less, its effects on quality were inconclusive. With higher initial moisture levels IPD would probably prove beneficial.

Hunter color saturation values of the reconstituted fruit slices more nearly reflected panel color scores than did soluble color values expressed as colorimeter readings obtained at a single wave length.

The limitations and possibilities of the 7 supplementary treatments and of 4 types of packaging used are discussed with regard to desirable future investigations.

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Random vs. Stratified Sampling Methods for Tomato Inspection

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IN GENERAL, all food items that enter the field of commerce are subject to some form of pure food law. If the foods enter into interstate commerce, whether fresh or processed, Federal pure food laws determine the quality. In addition, individual states have their own food purity and sanitation codes.

These inspections fall into two classes:

(1) The inspection is made to examine quality from the standpoint of fitness for human consumption; this includes determinations of insecticide spray residues, bacterial and mold spoilage, and insect infestation or other factors related to public health. In this case, the food is either acceptable or rejected.

(2) The inspection is made to determine the degree of quality after the food has been found acceptable. This includes grading for quality, an established standard.

In most cases the inspection is made on the basis of percentage defects, and compared with tolerances set for defects of types (1) and (2) mentioned in the foregoing paragraph. Potatoes are graded for diameter size, shape, and tissue injury due to climatic conditions of growing or to mechanical means, along with damage due to mold and bacteria. Dried fruits are standardized according to mold, insect infestation, condition of maturation and general physical conformation. Some fruits and vegetables, such as tomatoes for cannng purposes, may be accepted or rejected on the basis of percentage defects in the overall. Along with these is the qualification of sanitation, which requires that the product be free of dirt and foreign matter.

FOUNDATION FOR SAMPLING

The above-mentioned inspections are dependent upon a reliable sampling procedure in order to assess the value of the whole lot. It is evident that an inspection of each specimen in every container in the lot is impractical. The approach to the problem of sampling so as to obtain a true representation of the lot, within definite limits, has statistical theory for its basis. This method has been tested and adopted for sampling many types of population where heterogeneous groupings are involved. In general, it depends upon all units having an equal probability for being included in the sample and sets definite limits and intervals of confidence for the range of variability.

The dependence upon an equal choice chance means that the sample must be obtained in a *random* manner; i.e., there are no restricting external forces operating to produce a bias for any particular method in drawing the sample. One such bias would be the case in which, for the sake of convenience, only the outside boxes in a load are inspected. A sample thus taken would not be representative of the whole load.

Fruits and vegetables are representatives of non-uniform distributions and each lot is subject to great variability. Each single fruit may vary due to difference of position on the plant and position of plant in the field plot. The fruit may then vary in size, ripeness and may have varying degrees of sunburn, mold or rot, worminess, coloring, etc.

The two measures which identify a sample in some characteristic are the mean value, $\overline{X}$, and the standard deviation, s, which are estimates of the population mean, m, and standard deviation, σ, respectively. To estimate the confidence limits for the population mean value from the sample data, a formula is given (4):

$$m = \overline{X} \pm (t)\ (s_{\overline{x}}) \qquad \text{(A)}$$

where t = *Student's t*-value at some predetermined probability level, usually 0.05;

$s_{\overline{x}}$ = standard deviation of the mean $= \frac{s}{\sqrt{N}}$

N = size of sample

PRACTICAL SAMPLING

Theory requires the use of a sampling technique that yields the smallest standard deviation for any given size sample in order to obtain the highest efficiency. The usual sampling designs include simple random, stratified random and cluster sampling; these are well-described elsewhere *(2, 6)*, along with the optimum employment of each.

The size of sample determines the degree of confidence but, as sampling cost is directly proportional to the size of sample, a compromise must be decided between cost and accuracy of estimate. Size of sample should also be influenced by practices previously used and judged successful *(10)*. In the handling of fruits and vegetables, some factors tend to decrease and others to increase the required size of sample for any determined degree of accuracy *(11)*.

One method adopted for fig and walnut testing *(7, 8)* requires the selection of a number of containers taken at random equal to the square root of the total containers in the lot. Another method, for the determination of soluble solids (° Brix) in boxed and gondola-loaded grapes for wine production *(1)*, is based upon controlling the range of mean values between samples.

A method for grading tomatoes is given *(9)*, which recommends the random drawing of 10 tomatoes from each of 10 baskets, or multiples thereof, depending upon the desired precision; however, it is stated that there may be difficulty or impracticality involved in randomly selecting as many as 10 baskets.

This paper deals specifically with the sampling of canning tomatoes, as they are delivered to the processor, and compares a random method employed by the Bureau of Fruit and Vege-

table Standardization, State of California, with a stratified sampling technique.

Sampling procedure. The inspection of canning tomatoes is made for certain defects, the percentage of which (as determined by sample) determines the acceptance or rejection of the lot. The specific tolerances are given in Section 762 of the Agricultural Code of California and covers worm damage, mold, rot, coloring and defects caused by weather conditions.

The entire contents of each box in the sample (each box approximately 50 lbs.) is sorted for the above defects, and the defects are expressed as a percentage of the whole sample. The entire contents of each box is used rather than selected tomatoes, due to the difficulty in randomly selecting tomatoes from each individual box. The total defects must not exceed 15% by weight.

To guard against the occasional poor sample, a resampling is always made on a lot found to contain between 15% and 18% defects, and an average taken of the two gradings.

The sampling method in use is random in nature. The designation of the boxes to comprise the sample is done in a purposive rnadom manner. Considering the truck load as a parallelopiped comprised of box units, the sampling requires a selection of boxes from the load such that the sample shall not include more than one box from any one tier, row or layer. Further restriction is enforced by the stipulations that approximately one-half of the boxes must be taken from inside rows and at least one box of those selected from outside rows must be taken from either the fifth layer down from the top of the stack if 7 layers high or more, or otherwise, the next to bottom layer. This procedure eliminates the possibility for drawing the sample from any one general area.

A suitable sample size was determined after a number of years' experience, taking into account the difficulty of sampling and resampling, and the degree of accuracy desired. The sampling is as follows:

Under 50 box lot, 2 box sample
51–100 box lot, 3 box sample
101–300 box lot, 4 box sample
301–400 box lot, 5 box sample
401–600 box lot, 6 box sample
601–800 box lot, 7 box sample
Over 800 box lot, 8 box sample

This manner of sampling has proven successful throughout the years. Evidence for this is the fact that in cases where the original sampling required a re-inspection (15–18% defects), the resampling did not produce a reversal of reject decision in 95% of the cases. This would indicate that the 95% confidence interval for rejection is somewhere around +3% defects.

The above method was compared with a stratified sampling design. Since the load consists of a number of pallets, each containing 40 boxes of tomatoes, the pallets were considered as strata. The sampling was performed in two ways; (a) one box was randomly selected from each and every pallet in the load, a one-box stratified sampling, and (b) two boxes were randomly taken from each and every pallet, a two-box stratified sampling. There was a total of 434 loads so sampled in three inspection districts. The loads were of 240, 320 and 480 boxes, corresponding to 6, 8 and 12 pallets, respectively.

DISCUSSION

The number of boxes needed to comprise a sample by either the usual random, one-box stratified or the two-box stratified sample design are given in Table 1. It is seen that the one-box stratified method required a sample size of 1½ to 2 times and the two-box sampling demanded a sample 3 to 4 times that for the usual method.

Calculations were made to determine the value of the standard deviation of the mean percentage defects, $s_{\bar{x}}$, by these three methods. While the range was broad for the deviations, reasonable estimates were obtained by averaging within ranges of percentage defects. The data are given in Table 2.

From the table it is noted that $s_{\bar{x}}$ increases with increasing defects. This is to be expected since the more perfect the fruit, the more uniform the loads become.

It is further noted that the one-box stratification program is not any more efficient than the usual purposive random method, as measured by $s_{\bar{x}}$, in spite of the fact that the sampling ratio is greater. This would denote that the chosen strata are quite heterogeneous, the imperfections varying greatly within each stratum. By drawing a two-box sample from each of the strata, a better estimate is derived.

TABLE 1

Boxes needed in sample from loads of various sizes for 3 methods of sampling

Load size (boxes)	Sample size (boxes)		
	Usual random method	1-box stratified method	2-box stratified method
240	4	6	12
320	5	8	16
480	6	12	24

Since $s_{\bar{x}}$ is inversely proportional to the square root of the sample size for any given design, doubling the sample size for the usual method would yield a value (in the range of 15–18% defects) of 1.55 (taken from Table 2) divided by $\sqrt{2}$. This value is 1.10 and is roughly equal to that for the two-box stratification. This signifies that a random, purposive sample of 8–12 boxes (depending upon the size of the load) would yield as efficient estimates of variability as the two-box sampling requiring 12–24 boxes per lot.

TABLE 2

Average standard deviation of the mean for 3 types of sampling in 4 ranges of percentage defects

Defects (range)	Standard deviation of the mean (in percent defects)		
	Usual random method	1-box stratified method	2-box stratified method
Under 5%	0.86	0.78	0.45
5–10%	1.25	0.98	0.68
10–15%	1.43	1.43	1.02
15–18%	1.55	1.66	1.11

An interval of confidence may be calculated for the true mean value from the sample mean by formula (A) given earlier in this paper:

$$m = \overline{X} \pm (t)\ (s_{\bar{x}}) \quad \text{.....(A)}$$

If the 95% level of confidence is adopted, a value for t is used at the 5% level, termed $t_{.05}$. If it is assumed that the distribution of the sample mean values is reasonably normal, there is no reason to believe that the probability given by the tabled values of t will be

seriously in error *(3)*. A table of *t*-values is given *(5)*.

The value for $s_{\bar{x}}$ for the random method is given by Table 2, in the range of 15–18% defects, as equal to 1.55% defects. Assuming an average sample size of N = 5 boxes, the degrees of freedom with which to enter the *t*-table are N — 1 = 4, and the $t_{.05}$ value is 2.776. The 95% confidence interval for the true mean is therefore

$$m = \overline{X} \pm (2.776)\ (1.55) = \overline{X} \pm 4.30\%$$

If one particular sample in the test grading yields a value of 15% defects, the true mean would be found, in 95% of the cases, between 15 ± 4.30, or between 10.7% and 19.3%.

The above values appear to be in a wide range, but the resampling procedure in the range of 15–18% defects allows for reclassifying the lot if the true mean were actually under 15%.

One fault with retesting only those samples revealing 15–18% defects lies in the fact that sample values lower than 15% will allow a number of lots to be accepted which contain actually more than 15% defects. One improvement would be to re-examine all loads between 12 and 18% defects, as determined by the sample. On this basis, a sample revealing 12% defects would reflect a true mean of m = 12 ± 4.30, or in the range of 7.70 to 16.30, for the 95% level of confidence. This would reduce the hazard for accepting a bad lot.

Another possible improvement would be to increase the sample size, which would narrow the range for the true mean and reduce the number of re-samplings necessary. The question of practicality is involved, however, due to the larger original sample taken.

In the specific case of tomato sampling a unique situation exists. Table 3 gives the California total and

TABLE 3

Total and percentage tonnage California processed tomatoes classified in 4 groups of percentage defects for 1952, 1953, 1954

Year	Percentage defects			
	Under 12	12–15	15–18	Over 18
	Tons and percentage			
1952	1,715,098 (98.91%)	11,850 (.68%)	3,769 (.21%)	3,105 (.20%)
1953	1,371,510 (99.57%)	3,756 (.27%)	1,086 (.08%)	1,052 (.08%)
1954	1,326,102 (99.55%)	4,269 (.32%)	1,164 (.08%)	632 (.05%)

percentage total tons for round type canning tomatoes falling into four groups of percent general defects (as cited in the Agricultural Code), as determined by representative sample. These values are given for the years 1952, 1953, and 1954. It is noted that about 99% of all loads contained less than 12% defects. The fractional percent falling in the 12–15% defect class contributed only an insignificant amount to the general quality of the whole tonnage. As a general practice, re-sampling of loads in this class would seem a waste of effort and money. The retesting of samples in the range of 15–18% defects is necessary to guarantee a fair test and serves as an important day to day check on the reliability of the specified sampling method.

SUMMARY

Practically all foods are subject to some form of pure food law. To determne the defect characteristics, inspections are made by sampling of the lots. The sampling must be conducted in such a manner as to be representative of the whole lot. Fruits and vegetables are particularly heterogeneous in character throughout any one lot, and it is necessary to employ sampling methods based upon statistical theory in order to evaluate the lot.

This study dealt specifically with a standardized method for inspection of the percentage defects in tomatoes for use in canning. A comparison was made between a purposive random and stratified random design. Intervals of confidence for the true mean value of the defects were established from the data.

It is suggested that each samplng procedure have an inherent day by day check test.

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Influence of Plastic Vat Cover on the Fermentation of Cucumbers[a, b, c]

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SANITATION in the brining of cucumbers for pickle processing has not kept up with sanitary practices followed by other segments of the food industry. The methods involved in brining cucumbers commercially lend the operation to considerable filth contamination. Ordinarily the cucumbers are transported from the field, as they are picked, to a salting station where they are dumped into large vats (400–1400 bu. capacity) and brined. During the ensuing fermentation, curing, and storage, the vats are open to anything that happens along and by mischance falls in. Insects, particularly, are a major problem as they are attracted by the reflection from the brine surface and once they alight they are usually entrapped.

Blakemore *(1)* has reported that vinyl tank covers have been used very successfully by The Clyde Kraut Company, Clyde, Ohio, to keep out dust and filth contamination and to reduce losses due to top spoilage. At the end of the 1952–53 kraut season when the covers were first used, it was reported that the covers had greatly improved sanitary conditions, made a material saving in the waste product, and improved the quality and flavor of the kraut.

As a method of contamination prevention in cucumber fermentations, polyethylene films of 1.5, 2.0 and 3.0 mil gauges have been used. The effect of these vat covers on the fermentation processes and the finished pickle products have been studied and evaluated.

EXPERIMENTAL PROCEDURE

The cucumbers (Ohio MR-17) were picked and transported to the laboratory in the morning. The following afternoon the cucumbers were roughly sorted to cull out the extra large, damaged and discolored stock. Ten 110-lb. lots of the acceptable stock were weighed. Weighed lots of cucumbers were moved outside to an open area a short distance from the laboratory and placed in ten, 21 gallon white oak vats. Vats were placed in an east-west position with 1, 2, 3, 4 and 5 in a row and 6, 7, 8, 9 and 10 in a parallel row, with vat 1 being opposite vat 10. This positioning exposed the east end vats to shading in the morning till approximately 9:30 and the west end vats in the afternoon beginning at about 4:30. A 10.5% (40° Salometer) salt brine was used to cover the cucumbers and fill the vats to capacity. A wooden false head was placed on top of the cucumbers to keep them submerged in the brine which after equalization with the cucumbers ranged from 39–23° Salometer. Vat covers used were: Treatment I (vats 1 and 6) 1.5 mil polyethylene film; Treatment II (vats 2 and 7) 2.0 mil polyethylene film. Treatment III (vats 3 and 8) 3.0 mil polyethylene film. Treatment IV (vats 4 and 9) 1.5 mil polyethylene film submerged under a 2 inch layer of water, and Treatment V (vats 5 and 10) uncovered as controls. All the films were secured with ½ inch rubber bands, so that they were in contact with the brine surface.

Starting the following day, two samples were siphoned from each of the 10 brines periodically throughout the fermentation period. The smaller sample (10 ml.) was used for a microbiological study and the larger sample (200 ml.) was used for chemical determinations. On the same days that the brine samples were taken, a temperature check was made of the brines. The temperatures were taken at approximately 3 o'clock in the afternoon.)

A 1-ml. aliquot was taken from the microbiological sample and employed for the preparation of index dilution plates, using differential media. A least 2 dilutions were poured for each medium. A brillian green bile medium *(3)* was used for the coliform bacteria. The modified V-8 medium suggested by Fabian *(5)* was used for the lactobacilli and an acidified dextrose medium *(3)* was used for the yeasts. The plates were inverted and incubated for 24, 48 and 72 hours, respectively. The remainder of the microbiological brine sample was used for a turbidity measurement with a Bausch and Lomb Spectronic 20 colorimeter. The instrument was adjusted to 625 mμ and standardized at 100% transmittance with double distilled water.

The second brine sample was used for a determination of salt content, pH, and total acidity. Salt content of the brines was determined by a salt hydrometer calibrated in degree Salometer (1% Salt = 3.8° S). For the pH and total acid determinations, a 10-ml. aliquot was taken from the brine samples and diluted with approximately 100 ml. of double distilled water. The diluted brine sample was heated to the boiling point and then cooled. The pH of the sample was determined by a Fisher Titrimeter and total acid was determined by titration with .1N NaOH to a 7.5 pH end point.

At the end of the fermentation period the density of the brines was increased 3–4° Salometer each week by the addition of 2 lbs. of salt until a 60° Salometer brine concentration was reached. At the same time the salt was added, the brine level was brought back to full capacity of the vats (except Treatment IV—vats 4 and 9) by the addition of an equal density brine. The brines were also circulated by a variable speed, positive displacement pump at the rate of 4 gallons per minute for 2 minutes.

Upon completion of a curing period, which lasted approximately 2 months, the cucumbers (now referred to as salt stock) were brought back into the laboratory for processing. The brine was drained and the stock weighed. The brine and salt stock was examined for insects and insect fragments. A representative sample was taken from each vat and stored, later to be used for puncture tests and bloater counts. A U. S. Department of Agriculture pressure tester with a 5/16 in. blunt tip was used for the puncture tests. Desalting was carried out with circulating tap water. The water was changed 3 times at 12-hour intervals. On the last water change alum and

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[b] Contribution from the Missouri Agricultural Experiment Station, Journal Series No. 1637.

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turmeric were added and the water was heated to 150° F. The stock,after desalting, was culled rather severely, and graded subjectively into 3 size lots which were processed into sweet, sour, and dill pickles.

The pickles were presented to a taste panel for texture evaluation by the method of paired comparisons. To the element of each pair that possessed better texture, the judge gave a rank or a score of one, if it had less, he recorded a value of two. Estimate of treatment ratings are provided in a pairwise fashion, using the rank analysis of a completely balanced incomplete block design as suggested by Bradley and Terry *(2)*. Along with the texture evaluation, the panel picked the sample within a series (6 samples—3 pairs) that possessed the best flavor.

In a preliminary study, polyethylene, vinyl and Saran films were evaluated for their application as vat covers by their transmission of lethal ultraviolet light. Several yeast stains obtained from the Northern Regional Utilization Laboratory, U. S. Department of Agriculture were used as test organisms. Acidified dextrose agar plates were poured and surface inoculated with a 1: 10,000 dilution of suspended yeasts. Films were wiped clean with 95% ethyl alcohol, placed over the top of the petri dish, and secured with rubber bands. Petri dish covers served as controls. Plates were then placed in a dark enclosure and exposed to ultraviolet light for 30 minutes. An ultraviolet lamp (Pasteuray PL-15, Germicidal)[4] mounted 90 cm. above the plates served as the light source. After the 30-minute exposure the lamp was turned off and the plates were incubated at room temperature for 72 hours. Growth was estimated subjectively.

Where the experimental designs had been adapted to statistical analysis, the analyses of variance were applied.

RESULTS AND DISCUSSION

Temperature of the brines during fermentation. Plastic vat covers were found to affect the temperature of the brines during fermentation. The analysis of variance of the data presented in Table 1 show that treatment was significant at the .01 level with a least significant difference value of 2° F. Treatments II (vats 2 and 7) and III (vats 3 and 8) have significantly higher mean temperatures as compared to Treatment V (control vats 5 and 10). Replication was not significant.

The incubation temperatures used by Pederson and Albury *(7)* had a marked effect upon bacterial content, types of bacteria, rate and degree of fermentation, and rate of curing of the cucumber stock. On the basis of their studies, temperatures of 75° to 86° F. seem to be optimum for the fermentation and curing of cucumbers. Mean temperatures of all the vats fell within this suggested optimum temperature range. The association of air temperature and relative humidity with brine temperature is of interest. On September 17th, the hottest day during the fermentation period, the air temperature was 92° F. with a relative humidity of 30% as compared with the brine temperatures which ranged from 85° to 90° F. Vats 4, 5, 9 and 10 had temperatures of 85° F.; vats 1, 2, 3, 6, 7 and 8 had temperatures of 90° F. Under these conditions, evaporation and thus cooling was pronounced in vats 4, 5, 9 and 10 as indicated by the lower temperatures. On September 26th, the coldest day during the fermentation period, the air temperature was 68° F. with 85% relative humidity. All the brine temperatures on this particular date were 64° F. indicating that under such conditions very little evaporation and cooling occurred in vats 4, 5, 9 and 10. Another factor that readily pointed out the low evaporation rate in the covered vats (except 4 and 9) was the amount of brine required to bring the vats back to full capacity each time salt was added. Vats 1, 2, 3, 6, 7 and 8 generally required the addition of

[4] Supplied by the Pasteuray Corporation, St. Louis, Missouri.

TABLE 1

The influence of plastic vat covers on temperature of the brines during fermentation

Date	Brines Temperature in Degrees Fahrenheit									
	1	2	3	4	5	6	7	8	9	10
9–14–55	81	81	81	81	81	81	81	81	81	81
9–15–55	93	87	92	85	87	85	87	87	89	85
9–16–55	85	89	90	90	85	87	87	87	87	85
9–17–55	90	90	91	85	85	90	90	90	85	85
9–18–55	91	89	90	88	86	90	88	90	89	85
9–19–55	83	87	85	81	82	86	85	86	82	81
9–20–55	83	83	83	85	81	83	83	81	80	81
9–21–55	80	80	81	81	80	80	80	80	79	79
9–23–55	73	73	73	73	73	73	73	74	73	73
9–26–55	64	64	64	64	64	64	64	64	64	64
9–28–55	78	78	79	81	78	76	78	78	78	75
9–30–55	77	76	75	81	85	86	87	87	71	73
10– 3–55	72	73	71	73	70	73	74	75	73	70
10– 5–55	71	70	70	70	70	70	70	70	70	70
10– 8–55	70	71	72	71	69	71	69	68	65	67
Total	1191	1191	1197	1189	1176	1195	1196	1198	1166	1154
M	79.4	79.4	79.8	79.3	78.4	79.7	79.7	79.9	77.7	76.9

Summary of analysis of variance

Source	D.F.	M.S.	F. Ratio
Total	149		
Treatment	4	25.0	5.47**
Dates	14	596.7	130.56**
Replication	1	8.0	1.75
Remainder	130	4.57	

Least Significant Difference at the .01 level = 2° F.
** Significant at the .01 level.

⅓ to ½ gallon of brine whereas vats 5 and 10 required ¾ to 1½ gallons. Vats 4 and 9 had very little brine loss as most of the evaporation occurred from the two inch water layer on top of the film.

The retention of heat by the brines due to the vat covers could well be beneficial to fermentations started late in the season. A few degrees increase in temperature may be sufficient to increase the initial rate and extend active fermentation.

Total acid. The total acidity of the brines expressed in ml. of .1N NaOH required to neutralize the 10 ml. sample is tabulated in Table 2. The analysis of variance of the data shows that treatment was significant at the .01 level. When the least significant difference was applied to the mean values, it was found that Treatments I (vats 1 and 6), II (vats 2 and 7), III (vats 3 and 8) and IV (vats 4 and 9) had significantly higher mean total acid as compared to Treatment V (control vats 5 and 10). Replication was not significant.

The maximum acid content was reached on the 16th day (9–30–55) of fermentation. The total acid, expressed as lactic, on this particular date ranged from .66% for control vat No. 5 to .86% for covered vat No. 2, a difference of .20%. These acidities are comparable to the upper and lower limits reported for most commercial fermentations. Both of the control vats, 5 and 10, were lagging behind the cover vats in total acid production throughout the active fermentation period, which lasted approximately 3½ weeks. Thus, the data indicate that the plastic vat covers produced an environment conducive to a more rapid rate of acid production as well as to a higher total acid production.

Total microbiological growth. The total microbiological growth which is reported as percent transmittance at 625 mμ, was found to be affected by the plastic vat covers. Table 3 shows that treatment was significant at the .01 level with a least significant difference value of 7.01%. Treatments I (vats 1 and 6), II (vats 2 and 7), III (vats 3 and 8) and IV (vats 4 and 9) had significantly lower mean transmittance values as compared to Treatment V (control vats 5 and 10). It was also found that Treatment III and IV were significantly lower than Treatment I. Replication was found to be significant at .01 level.

The relationship between the density of a cell suspension and the light transmitted is an inverse proportion, that is, the lower the reading the higher the cell density. Therefore, the covered vats had a much higher cell population. Maximum population as indicated by the data occurred on September 20th or seven days after fermentation began. This corresponds with the peak growth of the lactic acid organisms as indicated in Table 4. There is considerable variation between control vats 5 and 10 and the covered vats 1 and 6. A possible contributing factor to this variability between replicates appears to be the position of the vats with rference to the shading.

Colony counts on the V-8 medium. The V-8 medium was used to differentiate the lactic acid producing organisms and to follow their growth curve. Most of the lactic acid producing bacteria appeared to be lactobacilli. The data tabulated in Table 4 show that the plastic vat covers did not significantly affect the growth of the lactic acid organisms. Replication was significant at the .05 level with a least significant difference value of 197.2.

TABLE 2

The influence of plastic vat covers on total acidity of the brines during fermentation

Date	ml. .1N NaOH to neutralize 10 ml. brine									
	1	2	3	4	5	6	7	8	9	10
9–14–55	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
9–15–55	0.4	0.4	0.4	0.7	0.4	0.5	0.4	0.5	0.5	0.5
9–16–55	0.9	1.2	1.1	0.6	0.5	1.0	1.2	1.4	1.0	0.6
9–17–55	2.0	2.6	3.3	2.1	1.1	2.2	3.0	2.2	1.5	1.3
9–18–55	3.7	4.5	4.6	3.8	2.2	4.0	4.6	4.2	3.1	3.1
9–19–55	4.9	6.0	6.4	5.4	4.0	4.5	6.2	5.3	5.0	4.1
9–20–55	5.6	7.1	7.2	6.6	5.1	6.5	6.7	6.0	5.8	4.5
9–21–55	5.5	7.2	7.5	7.1	5.6	6.2	7.4	6.5	6.8	5.5
9–23–55	7.0[1]	7.5	8.6	8.2	7.5	7.2	8.3	9.1	8.5	6.8
9–26–55	7.4[2]	7.9	7.5	8.3	6.5	6.8	7.5	7.8	8.0	6.9
9–28–55	6.9	7.7	8.1	7.6	6.7	6.9	7.9	8.1	8.3	6.5
9–30–55	7.8	9.6	9.0	9.3	7.5	8.6	9.3	8.7	9.2	7.3
10– 3–55	7.3	8.0	7.9	8.2	6.7	7.6	8.1	8.3	8.4	6.9
10– 5–55	7.5	8.2	8.2	8.6	7.1	7.8	8.2	8.6	8.6	7.0
10– 8–55	7.6	7.7	7.7	7.7	5.0	7.3	8.0	7.1	8.0	6.4
Total	74.6	85.7	87.6	84.3	66.0	77.1	86.8	83.8	82.7	67.4
M	4.97	5.71	5.84	5.62	4.40	5.14	5.79	5.59	5.51	4.49

Summary of the analysis of variance

Source	D.F.	M.S.	F. Ratio
Total	149		
Treatment	4	9.24	47.38**
Dates	14	91.69	470.21**
Replication	1	.01	.05
Remainder	130	.195	

Least Significant Difference at the .01 level = .42 ml.

** Significant at the .01 level.

[1] Used the Beckman pH meter in place of the Fisher Titrimeter from this date on.

[2] A calculated value.

TABLE 3

The influence of plastic vat covers on microbiological growth during fermentation

Date	Percent Transmittance of the Brines at 625 Millimicrons									
	1	2	3	4	5	6	7	8	9	10
9–14–55	96	95	93	92	94	96	95	95	94	92
9–15–55	96	86	86	96	92	96	87	84	92	95
9–16–55	56	57	58	79	74	58	54	54	57	65
9–17–55	34	27	23	34	59	29	26	38	47	48
9–18–55	20	17	16	17	39	19	17	16	25	25
9–19–55	22	16	13	13	42	21	16	16	17	28
9–20–55	24	17	12	10	46	16	17	15	13	32
9–21–55	29	18	15	10	52	18	20	18	12	34
9–23–55	34	27	18	12	57	22	23	20	12	42
9–26–55	40	27	20	16	63	25	32	22	15	52
9–28–55	38	23	19	16	54	24	24	20	11	39
9–30–55	47	32	24	22	59	28	30	23	15	44
10– 3–55	53	41	29	33	65	38	42	30	18	49
10– 5–55	64	53	39	39	70	45	49	42	18	60
10– 8–55	64	50	42	36	70	52	49	38	22	58
Total	717	586	507	525	936	587	581	531	468	763
M	47.8	39.1	33.8	35.0	62.4	39.1	38.7	35.4	31.2	50.9

Summary of the analysis of variance

Source	D.F.	M.S.	F. Ratio
Total	149		
Treatment	4	2,682.66	49.62**
Dates	14	5,731.40	106.01**
Replication	1	775.20	14.33**
Remainder	130	54.064	

Least Significant Difference at the .01 level = 7.01%.
** Significant at the .01 level.

Most of the variation in replication can be contributed to the large variation between replicated vats 4 and 9 which had mean colony counts of 92.4 and 489.1 respectively. Vats 6, 7, 8, 9 and 10 had higher mean counts than did their respective replicates: vats 1, 2, 3, 4 and 5. In each replication the vats covered with the 3.0 mil polyethylene covers (vats 3 and 8) had higher mean counts than did any of the other covered vats except vat 9. As pointed out in the discussion of Table 3, the maximum population occurred on the 7th day after fermentation began.

Yeast and coliform bacterial populations were so small that they did not materially affect the active fermentation.

Bloater development. The effect of plastic vat covers on bloater development is shown in Table 5.

TABLE 4

Colony counts on V-8 media as influenced by plastic vat covers

Date	Dilution	Colony Counts of Samples									
		1	2	3	4	5	6	7	8	9	10
9–14–55	H	1	1	1	1	1	1	1	1	2	1
9–15–55	T	400	400	400	64	244	400	400	400	400	400
9–16–55	HT	305	230	245	90	125	340	190	205	250	210
9–17–55	HT	290	320	390	320	1020	81	300	213	500	570
9–18–55	HT	258	107	138	177	67	105	330	212	167	162
9–19–55	HT	226	246	253	85	47	151	390	216	155	160
9–20–55	M	11	11	29	12	2	17	26	8	20	10
9–21–55	HT	34	18	235	37	31	50	158	69	100	35
9–23–55	HT	19	120	60	27	7	9	102	190	96	26
9–26–55	HT	230	333	192	40	8	62	40	264	158	10
9–28–55	10T	42	36	265	20	64	270	220	410	400	82
9–30–55	10T	6	52	320	38	15	203	117	290	1720	39
10– 3–55	10T	2	22	57	43	10	62	6	124	330	17
10– 5–55	T	5	44	125	340	25	258	34	622	2550	56
Total		1829	1940	2710	1294	1666	1989	2314	3224	6848	1778
M		130.6	138.6	193.6	92.4	119.0	142.1	165.3	230.3	489.1	127.0

Summary of analysis of variance

Source	D.F.	M.S.	F. Ratio
Total	139		
Treatment	4	134,189.3	1.93
Dates	13	182,679.5	2.63**
Replication	1	321,984.2	4.63*
Remainder	121	69,501.4	

Least Significant Difference at .05 level = 197.7.
Least Significant Difference at .01 level = 260.7.
* Significant at .05 level.
** Significant at the .01 level.

Bloater counts were made on a representative sample of both the accepted and culled (misshapen and oversized "pumpkins") salt stock. Treatment IV (vats 4 and 9) had considerably higher bloater developments than did any of the other treatments in both the rejected and accepted stock. Control vat 5 had 40% bloater development in the rejected stock which is comparable to vats 1, 2 and 3, but vat 10 had only 26% development which is considerably less than the bloater development in vats 6, 7 and 8. Bloater development in the accepted stock was proportionally lower as compared to the rejected stock.

TABLE 5

Bloater development in salt stock as influenced by plastic vat covers

Vat codes	Bloaters		Total count		Percent bloaters	
	Rejected stock	Accepted stock	Rejected stock	Accepted stock	Rejected stock	Accepted stock
1	21	6	50	36	42	15.8
2	20	2	50	33	40	6.1
3	21	5	50	36	42	13.9
4	33	11	50	31	66	35.5
5	20	5	50	27	40	18.5
6	19	5	50	24	38	20.8
7	17	4	50	23	34	17.4
8	17	0	50	24	34	00.0
9	29	7	50	25	58	28.0
10	13	0	50	25	26	00.0

A reasonable explanation for high bloater development in the vats covered with the 1.5 mil polyethylene film submerged under water (vats 4 and 9) is that the water layer caused an air tight seal and prevented the escape of gases produced during fermentation. Etchells *et al. (4)* have reported in their study on fermentations that in the 20° brine, the gas evolved was principally carbon dioxide with a minor amount of hydrogen. The 40° Salometer cover brines were allowed to equalize with the cucumbers and the resulting brines after 3 days had a density of 20–23° Salometer.

No logical explanation can be offered for the variation in replication.

Center puncture values. The effect of plastic vat covers on firmness as determined by center puncture values is presented in Table 6. Treatment was found to be significant at the .01 level with a least significant difference of 2.97 lbs. Treatment III (vats 3 and 8) was found to have a significantly higher mean puncture value as compared to Treatment V (control vats 5 and 10). Difference in size was found to be significant at the .05 level with a least significant difference value of 2.2 lbs. Replication was not significant.

The puncture test as a method of determining firmness in salt stock has been introduced in recent years. Jones *et al. (6)* have used the U. S. Department of Agriculture pressure tester in evaluating cucumber varieties for commercial salt stock. These workers have reported that size No. 2 fruit (1⅜ in. to 1½ in. in diameter) is always firmer than size No. 1 fruit (1 in. to 1⅛ in. in diameter) in lots considered free from enzymatic softening. If only the larger sizes had been used for the puncture tests in this study, the mean values would have probably been higher than those reported.

Insect contamination. Insect contamination was greatly reduced in the covered vats as indicated by the data in Table 9. Total insect counts ranged from 0 for some of the covered vats to 72 for a control vat.

TABLE 6

Center puncture values of salt stock as influenced by plastic vat covers

Diameter of stem end in inches	Puncture values expressed in pounds									
	1	2	3	4	5	6	7	8	9	10
25/16	18	17	12	12	14	14	18	20	14	15
24/16	18	15	24	16	18	19	16	18	17	16
23/16	13	12	20	18	13	17	16	16	11	15
21/16	11	16	14	16	14	19	13	18	13	12
20/16	19	17	15	16	16	15	14	17	13	13
19/16	15	16	14	14	17	20	14	16	17	14
19/16	15	15	14	10	15	18	19	20	15	13
18/16	21	17	23	18	16	18	14	15	18	21
17/16	20	13	20	21	13	27	13	25	12	16
17/16	15	15	21	15	17	15	17	17	19	11
17/16	14	13	9	15	18	21	17	19	15	13
14/16	18	18	23	14	14	15	11	20	16	11
12/16	16	13	17	12	15	16	14	12	12	11
Total	213	197	226	197	200	234	196	233	192	181
M	16.4	15.1	17.4	15.2	15.4	18.0	15.1	17.9	14.8	13.9

Summary of analysis of variance

Source	D.F.	M.S.	F. Ratio
Total	129		
Treatment	4	50.7	6.45**
Sizes	12	16.9	2.15*
Replication	1	0.00	0.00
Remainder	112	7.862	

Least Significant Difference at .05 level = 2.2 lbs.
Least Significant Difference at .01 level = 2.9 lbs.
* Significant at .05 level.
** Significant at .01 level.

Texture and flavor. The effect of plastic vat covers on texture and flavor of finished dill, sweet and sour pickles is presented in Table 7. The lower score indicates that that sample was picked as having the better texture. The asterisk indicates the sample picked within a series (6 samples—3 pairs) as having the best flavor. Two or more asterisks within the same series indicates that the samples received duplicate scores. The sample picked as having the better flavor was not necessarily the one with the lowest texture score. The dill pickles had probability values ranging from .0000 to .0324 which indicates that treatment was highly significant. The sweet pickles had probability values ranging from .0082 to .6976 and the sour pickles had probability values ranging from .0039 to .6575.

TABLE 7

The influence of plastic vat covers on the texture and flavor of pickles

Panel scores of samples					No. of tasters	P value
(1–6)	(2–7)	(3–8)	(4–9)	(5–10)		
Dill Pickles						
....	....	35	23	23*	9	.0005
....	....	33	28	20*	9	.0011
20	23*	....	....	29	8	.0324
18	23*	....	....	31	8	.0003
23*	31	....	....	36	10	.0025
24	26*	....	....	40	10	.0000
....	....	21*	30*	30*	9	.0208
....	....	23*	25	33	9	.0166
Sweet Pickles						
16	19*	....	....	19	6	.6575
14*	17	....	....	23	6	.0082
....	....	23	20*	20*	7	.6976
....	....	18*	21	24	7	.1992
24	....	20*	....	28	8	.0758
21	....	24*	....	27	8	.2447
Sour Pickles						
16	16*	....	....	22	6	.0976
15	18	....	....	21*	6	.1504
....	....	21	18*	24	7	.1992
....	....	22	16*	25	7	.0185
21	16*	....	....	26	7	.0076
19*	17	....	....	27*	7	.0039
....	....	17	17	20*	6	.6575
....	....	15*	19	20*	6	.3139

* Indicates the sample picked as having the best flavor.

Transmission of ultraviolet light by the various plastic films. The lethal effect on yeast of ultraviolet light transmitted by the plastic films is presented in Table 8. It was found under the experimental conditions previously described that the 1.5, 2.0 and 3.0 mil polyethylene films transmitted ultraviolet light in the effective wave length (2537°A) to produce a lethal effect. The vinyl and Saran films were found to block the ultraviolet rays to the extent that the yeast growth underneath them was comparable to the growth under the petri dish covers.

The occurrence of occasional growth on the plates covered with the polyethylene films could have been caused by several contributing factors. Most of the growth that did occur was along the outer edge of the plates. The position of the plate in relation to the ultraviolet lamp caused the side of the petri dish to

TABLE 8

The lethal power on yeast of plastic film transmitted ultraviolet light

Yeast code	Covers						
	Vinyl	Saran	1.5 mil Polyethylene	2.0 mil Polyethylene	3.0 mil Polyethylene	Control I[1]	Control II[2]
Y-301	xxxxxx[3]	xxxxxx	x	x	x	xxxx	xxxx
Y-1096	xxxx	xxxxx	x	x	x	xxxx	xxxxxx
Y-2240	xxxxx	xxxxxx	....	....	....	xxxxx	xxxxxx
Y-1089	xxx	xxx	....	....	x	xxx	xxx
Y-1567	xxxxx	xxxxxx	xx	xx	....	xxxxx	xxxxx
Y-132	xxxx	xxxx	....	....	....	xxx	xxxx
Y-978	xx	xx	....	....	....	x	xx
Y-862	xxxxx	xxxx	x	....	....	xxxxx	xxxxx
Y-1079	xxx	xxx	....	....	....	xxx	xxx
Y-775	xxxxxx	xxxxxx	xx**	xx**	xx	xxxxx	xxxx
Y-2021	xxxxxx	xxxxxx	x	x	x	xxxxxx	xxxxxx
Y-2214	xxxxxx	xxxxxx	xxx	xxx	xxx	xxxxxx	xxxxxx
Y-129	....	....	....	....	....	x	....
Y-1188	xxxx	xxxx	....	....	....	xxx	xxx
Y-2007	x	x	....	....	....	xx	xx
Y-1011	....	x	....	....	....	x	x
Y-659	xx	xx	....	....	....	xx	xx

[1] Incubated with a glass cover under the ultraviolet lamp.
[2] Incubated at room temperature away from the ultraviolet lamp.
[3] Growth codes.

....	No growth	xxxx	Medium growth
x	Very light growth	xxxxx	Medium heavy growth
xx	Light growth	xxxxxx	Heavy growth
xxx	Medium light growth	**	Sub Surface Colonies

cast a shadow thus blocking part of the light. A second possible explanation for the occasional growth is that the film covering adjacent plates could have been overlapping. A few of the plates had subsurface growth as some of the colonies became entrapped in an air bubble in the process of shaking the plate to get even distribution of the inoculum. From the data

TABLE 9

Insect counts in the vats as influenced by plastic vat covers

Vat	1	2	3	4	5	6	7	8	9	10
Counts	0	0	0	0	20	1	2	0	0	72

presented it is shown that any of the polyethylene films would be suitable for covering cucumber vats from the standpoint of controlling film yeast by the transmitted ultraviolet fraction of sunlight. Both the Saran and vinyl would be unsuitable from this standpoint as they have a blocking effect.

SUMMARY

A study has been made to evaluate the use of plastic vat covers in cucumber fermentation as a method of contamination prevention.

Results obtained under the experimental conditions described give reason to believe that the application of vat covers will actually improve the fermentation processes and the finished pickle products while decreasing filth contamination.

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The Time-Temperature Tolerance of Frozen Foods

VII. Frozen Concentrated Orange Juice[a]

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Since frozen orange concentrate is unpasteurized or only mildly heat-treated, reliance for retention of original quality is placed on the maintenance of adequate refrigeration from producer to consumer. Lack of adequate refrigeration may result in undesirable changes in quality, particularly flavor and cloud.

It was the high incidence of cloud loss (separation) in unpasteurized orange concentrates at the consumer level that led to the industry-wide practice of heat-treating at the time of manufacture to partially stabilize cloud against changes caused by insufficiently low temperatures in the course of marketing.

Numerous studies at constant storage temperatures have been conducted to establish the limits of cloud and flavor stability at elevated temperatures in heated and unheated frozen orange concentrates *(2, 3, 4, 5, 6, 7, 9, 10)*. These studies have supplied valuable information, but it is unlikely that constant-temperature conditions are typical of the actual time-temperature conditions experienced by commercial frozen orange concentrates. Little is known of the effects of fluctuating temperatures in the life histories of commercial concentrates on cloud, flavor, and ascorbic acid. However, there is reason to expect they would be different from those encountered at constant temperatures. For example, preliminary results obtained during these studies have shown that during storage at temperatures of 0°, −10°, and even −95° F., frozen orange concentrates become more sensitive to loss of cloud when exposed later to elevated temperatures *(9)*. The significance of these results is that cloud stability determined in commercial concentrate at the time of manufacture may not apply when the same concentrate has aged even though no temperature abuse has occurred.

As part of a comprehensive program of time-temperature tolerance studies on frozen foods conducted by the Western Utilization Research and Development Division *(11)*, cumulative time-temperature tolerance studies under varied temperature conditions have been carried on with commercial frozen California orange concentrates. This paper is a report of the results.

EXPERIMENTAL

Orange concentrates used. The orange concentrates studied included 9 lots of commercial frozen orange concentrate manufactured during the seasons 1952 through 1955. The commercial samples included 5 unheated lots (A, B, C, E and F), and 4 heat-treated lots (D, G, H and I) representing products from 4 processing plants.

Pectinesterase determination. The pectinesterase (PE) content of each lot was determined by a previously described method *(6)*.

Ascorbic acid determination. Ascorbic acid was determined by the A.O.A.C. method *(1)*.

Derivation of simulated time-temperature patterns. The time-temperature histories were derived from thermograph records of actual frozen orange concentrate shipments, records of cold-storage warehouse and retail cabinet temperatures, and other data and information supplied by representatives of the citrus and frozen-foods industries. From this information it was apparent that a typical time-temperature history of a lot of frozen orange concentrate over a period of 1 year consisted of 5 stages: (I) producer's warehouse, (II) transportation, (III) terminal warehouse, (IV) wholesale and retail marketing, and (V) home refrigeration. From the records available, schedules of time-temperature patterns simulating these stages in the life history of frozen orange concentrate from producer to consumer were drawn up. These schedules included several abnormal temperature patterns. Inclusion of these high-temperature patterns should not be taken to indicate that they commonly occur under commercial conditions, or that they are more likely to occur in any one stage than another. These temperature deviations were as follows:

Producer's warehouse (Stage I). 0° F. for 1 month.

Transportation (Stage II). Records obtained showed 3 deviations, from mild to severe, that might occur: (1) a constant temperature of 10° F. for 10 days, (2) a constant temperature of 10° F. for 5 days followed by a steady rise in temperature to 20° F. in 5 days and (3) a constant temperature of 10° F. for 5 days followed by a steady rise in temperature to 40° F. in 5 days.

Terminal warehouse (Stage III). 0° F. for 6 months.

Wholesale and retail marketing (Stage IV). Three temperature deviations were found to be worthy of consideration: (1) a constant temperature of 10° F. for 14 days, (2) a constant temperature of 10° F. for 14 days interrupted after the sixth day by thawing to 60° F. in 12 hours and immediate re-cooling to 10° F. in 12 hours (corresponding to removal of concentrate from a retail cabinet and holding

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at room temperature while the cabinet is defrosted), and (3) a constant temperature of 20° F. for 14 days.

Home refrigeration (Stage V). The two most extreme temperature deviations likely to be encountered were 20° and 40° F. for 7 days.

Time-temperature histories employed. The time-temperature histories employed were executed in terms of product temperatures monitored by thermocouples embedded in cans of concentrate and connected to a multiple-point recorder. All abrupt changes from 0° F. to some temperature initiating a pattern and back to 0° F. at the end of the pattern were brought about in a period not exceeding 12 hours.

For each lot the basic time-temperature histories consisted of a total period of 1 year during which samples were exposed to cumulative and permutative sequences of temperature patterns simulating the 5 stages in the life history of frozen orange concentrates. Each freshly manufactured lot was first held for 1 month at 0° F. to simulate stage I. Samples from these lots next were exposed to 3 temperature patterns simulating stage II, and then held at 0° F. for 6 months to simulate stage III. Samples of each of the 3 variables from stage II followed by stage III next were exposed to the 3 conditions simulating stage IV. Samples of all combinations of variables obtained from the permutation of patterns of previous stages next were exposed to each of 2 final conditions simulating stage V. All samples were then held an additional 4 months at 0° F. to complete 1-year storage. Two separate control lots were held continuously at 0° and —10° F. for one year for comparison with samples from the time-temperature histories and for comparison with each other. A schematic diagram of these time-temperature histories applicable to lots A, B, C, D, E, and F is given in Figure 1.

Later, it became necessary to reduce the scope of the experiment by eliminating some of the temperatures from each pattern. Since the concentrates under study were heat-treated, only the more extreme temperature conditions were retained. The schematic diagram of this simplified time-temperature history is given in Figure 2 and applies to lots G, H, and I.

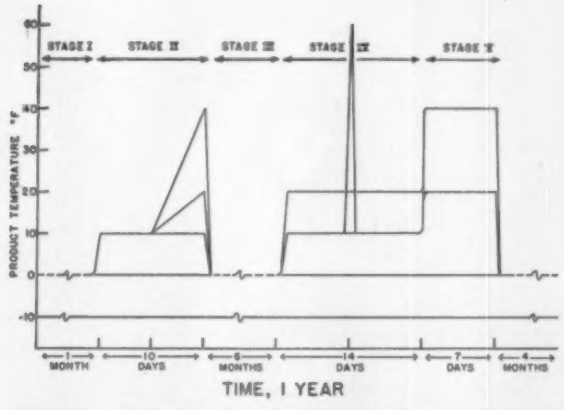

Figure 1. Schematic diagram of the time-temperature patterns employed with lots A, B, C, D, E, and F.

Because of the permutative nature of the experiment, the number of samples used, and complexity of time-temperature histories represented at the end of the experiment a simple coding system was required to identify each sample. The life history of a lot sample can be described by a number, a letter, and 2 additional numbers. The first number may be 0 or —10, representing controls held at these temperatures, or the number may be 10, 20, or 40, representing the highest temperature reached in stage II. The letter following the first number represents the lot. The next number (10, 60, or 20) represents the highest temperature encountered in stage IV, and the last number (20 or 40) represents the highest temperature encountered in stage V. Appropriate numbers were added to the sample code as it progressed through the time-temperature history. The block diagram (Figure 3) illustrates the method of permutating the samples through the time-temperature history of Figure 1, and illustrates use of the coding system. The illustration is for lot A.

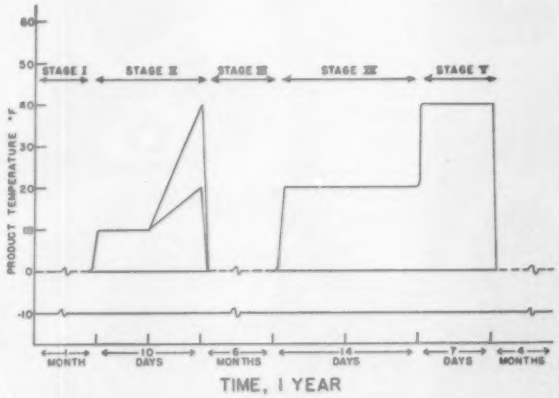

Figure 2. Schematic diagram of the abridged time-temperature patterns employed with lots G, H, and I.

Flavor evaluation. Flavor differences were evaluated by the triangular taste-test procedure previously described *(12)*. These tests were performed between stages and at midpoint during stage III. No evaluation was performed between stages I and II for obvious reasons.

For the most part samples were taste-tested in comparison with the 0° F. controls. However, it was anticipated that as soon as a flavor change occurred it would not be possible to detect a further change in succeeding stages by taste-testing in comparison with the same control. Therefore, following each stage in which a change occurred, aliquot samples were placed at 0° F. while the remaining samples were exposed to the next succeeding stage. The samples from the next stage were then compared with the changed samples from the prior stage. If no change had occurred in a prior stage, the controls held continuously at 0° F. were used. For example, if a flavor change occurred in those samples exposed to 40° F. in stage II, some would be held at 0° F. These samples then became the controls for those samples exposed to 40° F. in stage II followed by exposure to the temperature patterns in stage IV. In this manner it was assured that each flavor change detected by the panel was a new change resulting from conditions in a newly completed stage and not a flavor change carried over from a preceding stage. These special control samples are indicated in Figure 3.

Cloud determinations. Cloud was determined by the method of Loeffler *(8)* as modified and described elsewhere *(9)*. Determinations were made in duplicate on all samples when first received, between stages, and at the 3-month interval of stage III. This report will be based only on the "thawing index" (TI) values obtained *(9)*.

RESULTS AND DISCUSSION

Pectinesterase. Results of PE determinations are given in Table 1. These results are of interest for comparison with cloud stabilities discussed later. It will be noted that the PE content of the heat-treated lots are less than those of the non-heated samples.

Ascorbic acid. Losses of ascorbic acid did not exceed 5% of the initial content in any samples at any

time. This is in agreement with previous results of other workers *(3)*.

Changes in cloud during time-temperature histories employed. It is impractical to give the results of approximately 1,400 cloud determinations performed during these studies. Therefore, this report will consist of a generalized presentation of the results of cloud stability versus time-temperature history as presented in Tables 2 and 3. These tables list the

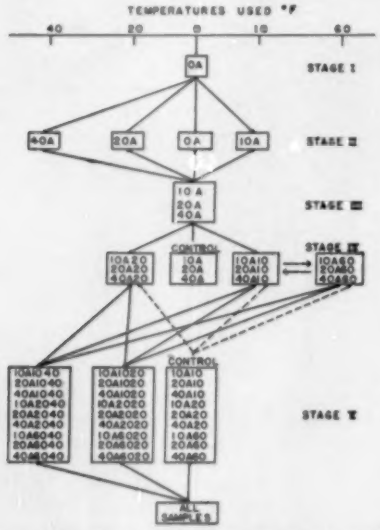

Figure 3. Schematic block diagram illustrating method of coding and the permutation of samples through the various patterns. For convenience in arrangement, temperature levels above 0° F. are shown on both sides of the zero axes.

temperature pattern code numbers of those samples in each lot whose cloud half-lives were not exceeded during each stage, i.e., those samples which retained more than 50% of their initial cloud through a given stage. Absence of a code number from the tables indicates that the sample having that code lost more than 50% of its initial cloud. The total possible code numbers arising from the time-temperature history illustrated in Figure 1 are shown in Figure 3. Those arising from the abridged history shown in Figure 2 omit the 10° F. temperature in stage II, the 10° F. temperature followed by the rise to 60° F. and back to 10° F. in stage IV, and the 20° F. temperature in Stage V.

TABLE 1

Pectinesterase content of commercial orange concentrates

Lot	PEa/ml. x 10^3 (42.5° Brix basis)
A—Unheated	8.4
B—Unheated	10.6
C—Unheated	13.2
D—Heated	3.3
E—Unheated	5.5
F—Unheated	6.0
G—Heated	2.4
H—Heated	1.6
I—Heated	3.8

The cloud half-life was an arbitrarily chosen endpoint for the simplified presentation of data in Tables 2 and 3. It does not represent an acceptable degree of cloud retention in frozen orange concentrates but may be regarded as a degree of cloud loss beyond which consumer complaints are certain to occur. It has been found in this and in previous studies *(4, 7)* that cloud loss, and therefore loss of quality, occurs in varying degrees in orange concentrates at all storage temperatures above 0° F.

TABLE 2

Samples retaining 50% or more cloud after each stage of time-temperature patterns in Figure 1 [1]
(Indicated by code numbers)

Stage I	Stage II	Stage IV	Stage V
OA	20 A	20 A 10	
	10 A	10 A 10	None
OB	10 B	10 B 10	
			None
OC	20 C	20 C 10	
	10 C	10 C 10	None
OD [2]	40 D	40 D 60	
		40 D 20	40 D 6020
		40 D 10	40 D 2020
	20 D	20 D 60	40 D 1020
		20 D 20	20 D 6020
		20 D 10	20 D 2020
	10 D	10 D 60	20 D 1020
		10 D 20	10 D 6020
		10 D 10	10 D 2020
			10 D 1020
OE	20 E	20 E 10	20 E 1020
	10 E	10 E 10	10 E 1020
OF	10 F	10 F 10	None

[1] During Stage III all samples were held at 0° F. with the exception of those held continuously at —10° F.
[2] Samples designated with the letter D were heated; all others in this table were unheated.

TABLE 3

Samples retaining 50% or more cloud after each stage of time-temperature patterns in Figure 2 [1]
(Indicated by code numbers)

Stage I	Stage II	Stage IV	Stage V
OG	20 G	20 G 20	None
OH	40 H	40 H 20	None
	20 H	20 H 20	
OI	40 I		
	20 I	20 I 20	None

[1] During Stage III all samples were held at 0° F. with the exception of those held continuously at —10° F.

Tables 2 and 3 show that none of the heated or unheated concentrates retained 50% of their cloud through the 40° F. exposure in stage V. Another general result shown in these tables is that in none of the unheated lots was cloud able to survive the 40° F. exposure in stage II, whereas cloud in all but one (G) of the heated lots survived this exposure. Adequate heat treatment, therefore, tends to protect commercial concentrates against this thawing experience.

Considering only the unheated lots (A B, C, E, and F), Table 2 shows that the most stable of these lots retained 50% or more cloud during the rise to 20° F. in stage II, but the least stable ones (B and F) did

not retain 50% cloud above 10° F. in these patterns. Those unheated samples which retained 50% or more cloud in these same patterns were also capable of retaining in excess of 50% cloud through the exposure for 14 days at 10° F. in the stage IV patterns. The fact that lots B and F retained 50% or more cloud during a total exposure of 24 days at 10° F. but suffered more than 50% cloud loss during the brief thawing to 20° F. suggests there is a sharp break in the effect of temperature on cloud stability between the temperatures of 10° and 20° F. This result is in agreement with previous studies at constant temperatures which showed that a sharp increase in rate of cloud loss occurred above 15° F. *(7)*. Lot E is seen to be exceptionally stable; samples exposed to either 10° or 20° F. in stage II and later exposed to 10° F. in stage IV also retained in excess of 50% cloud during the 7-day exposure at 20° F. in stage V.

Results of cloud retention in the heat-treated lots (D in Table 2, G, H, I in Table 3) indicate a higher degree of cloud stability than that of unheated lots, which is to be expected, but it is a matter of interest that the increase in stability was relatively small throughout the total time-temperature patterns. None of the heated lots retained in excess of 50% cloud during 7 days' exposure at 40° F. in stage V, and one of the lots (G) performed no better in stage II than the most stable unheated lots. The poor stability in stage V is, however, due in part to the recently discovered "sensitization" effect of storage *(9)*. Samples of lots D and H when freshly obtained retained more than 50% of their cloud when held at 40° F. for 7 days, but the control samples of these lots after 1 year at 0° and —10° F. failed to retain cloud to that extent under the same conditions.

Heat-treated lots were capable of retaining 50% cloud through the severe pattern employed in stage IV (20° F. for 14 days), but the results indicate that the previous temperature history in stage II may have had some effect on subsequent cloud stability. Whereas lots D, H, and I retained in excess of 50% cloud during exposure to 40° F. in stage II only those samples from lots D and H exposed to 40° F. in stage II retained in excess of 50% cloud after the 20° F. period in stage IV. Samples from lots I and G which retained 50% or more cloud during this latter condition were those exposed to 20° F. in stage II. This apparent cumulative effect is in harmony with previous results *(9)*. An unexpected result is the fact shown in Table 2 that the 60° F. pattern in stage IV appeared no more harmful to cloud in lot D than the 20° F. pattern. This result was verified by the cloud values obtained under the same conditions in the unheated lots. Although all unheated lots lost more than 50% cloud under both conditions, cloud loss was slightly less in all cases after the 60° F. pattern than it was after the 20° F. pattern. This indicates that short-term thawing at 60° F., when the temperature was otherwise maintained at 10° F. for this period, was no worse than a constant temperature of 20° F. for 14 days.

In general, unheated frozen orange concentrates retained 50% or more of their initial cloud through a time-temperature experience of 1 year at 0° F. with the exception of exposures to 10° F. that add up to as much as 24 days. A good proportion of the unheated samples also retained 50% or more cloud when thawed at least once to 20° F. if this temperature was not maintained. The cloud half-lives of heated commercial concentrates were not exceeded during 1-year storage at 0° F., except for a total cumulation of as much as 24 days at 20° F., and in most cases including one brief thawing to 40° F. if that temperature was not maintained.

Results of cloud determinations on control samples stored for 1 year at 0° and —10° F. showed no differences in cloud between these samples in any lots. The higher of these two temperatures should, therefore, be adequate for storage of commercial frozen orange concentrates.

The relationship of PE content to cloud stability in the lots studied was inconclusive. In the unheated lots the order of decreasing PE content was C, B, A, F, and E, whereas the order of increasing cloud stability was B-F, A-C, and E. Lot C, which had the highest PE content, was one of the three most stable, and lot F, which had the second lowest PE content, was one of the two least stable. Similarly, in the heat-treated lots the order of decreasing PE content was I, D, G, and H, whereas the order of increasing cloud stability was G, I, and D-H. Lot H with the lowest PE content was the most stable, but lot G with the next lowest PE content was the least stable. These results are in agreement with other results *(5, 6, 7)*, which indicate there is no 1 : 1 correspondence between PE content and cloud stability. Assumptions that this enzyme is wholly responsible for cloud loss may not be justified by the available facts.

Flavor changes during time-temperature histories. With the exception of a single lot sample exposed to a maximum time-temperature pattern (lot I exposed to 40° F. in stage II, 20° F. in stage IV and 40° F. in stage V), all flavor changes noted by the panel occurred in the unheated lots A, B, C, E, and F. These results suggest that flavor changes in unheated orange concentrates may be caused by enzyme action. Furthermore, it is unlikely that PE could be the cause of flavor changes, because the reaction products would be methanol and pectic acid, neither of which is a flavoring substance. It is possible that some flavor changes may result from the action of oxidative enzymes. Canned frozen orange concentrate is not anaerobic, and unheated samples have been found to be rich in catalase activity.[8] Catalase is capable of acting peroxidatively in the presence of traces of hydrogen peroxide, and therefore at least one oxidative mechanism may be present in unheated concentrates.

No flavor changes were observed in any lots at the end of stage II. The flavor changes which occurred

[8] McColloch, R. J. Unpublished data presented at Citrus Research Conference, Pasadena, California, Jan. 24, 1956.

during succeeding stages are summarized in Tables 4 and 5, in a form showing the cumulative effects of time-temperature histories on flavor stability.

In Table 4 the number of flavor changes found after stages IV and V are listed according to the previous stage II history. It is apparent that the largest proportion of samples showing flavor changes after these two exposures were derived from the highest temperature in stage II. This indicates that, although the stage II patterns alone produced no evident flavor changes, latent changes must have occurred which reduced flavor stability during the latter stages to an extent roughly proportional to the severity of the stage II pattern. In Table 5 the number of flavor changes noted after stage V are listed according to the severity of the preceding stage. Again it is seen that the greatest proportion of flavor changes after stage V were found in those samples derived from the most severe patterns in stage IV. In making this statement it must be remembered that cloud stability studies indicated that the 60° F. pattern in stage IV was equal to or slightly less severe than the 20° F. pattern in the same stage. A comparison of results after the 20° and 60° F. patterns in stage IV (Tables 4 and 5) shows that this is also true in the case of flavor stability. As a matter of fact, the 60° F. exposure appears to have had much less effect on flavor than on cloud.

TABLE 4

Cumulation of flavor damage through time-temperature patterns[1]

Stage II temperatures	Percent samples showing flavor damage						
	After Stage IV				After Stage V		
	10° F.	20° F.	60° F.	Total Stage IV	20° F.	40° F.	Total Stage V
10° F.	0	0	0	0	0	17	8
20° F.	0	11	0	5	17	19	18
40° F.	0	33	0	14	39	57	49

[1] A change is defined as a difference revealed by the triangle taste test between the controls held continuously at 0° F. and the lot samples in Stage IV, and between lot samples and one of two types of controls (explained in text) in Stage V.

TABLE 5

Cumulation of flavor damage through time-temperature patterns

Stage IV temperatures	Percent samples showing flavor damage After Stage V		
	20° F.	40° F.	Total Stage V
10° F.	0	28	14
60° F.[1]	17	22	19
20° F.	39	42	40

[1] See Figure 1.

The results given in Tables 4 and 5 indicate that the effects of time-temperature histories on flavor in orange concentrates are strictly cumulative. In general, flavor appears to be a relatively stable property of frozen orange concentrates. Few flavor changes (four) appeared before completion of the stage V patterns, and over half of all the flavor changes came after the most extreme cumulative time-temperature history employed (40° F. in stage II, 20° F. in stage IV, and 40° F. in stage V). In all cases, including the heat-treated samples, greater than 50% loss of cloud occurred before any change in flavor. Cloud is therefore the least stable property of the frozen orange concentrates used in this study.

After 1 year, no differences in flavor were found between controls stored at 0° F. and controls stored at −10° F. The higher of these temperatures appears adequate for retention of flavor as well as cloud in orange concentrates over a period of 1 year's storage.

SUMMARY

Results of time-temperature-tolerance studies of 9 lots of heated and unheated commercial frozen California orange concentrates show that there was no difference in cloud and flavor stability after storage for 1 year at 0° F. as compared to storage for 1 year at −10° F.

Studies of cloud and flavor changes in frozen concentrates throughout fluctuating time-temperature histories showed that in all lots cloud was less stable than flavor or ascorbic acid. However, there was no 1:1 correspondence between cloud stability and the pectinesterase content of the lots.

Commercial frozen orange concentrates varied widely in cloud and flavor stability. Differences in cloud stability occurred among the lots of heat-treated concentrates as well as among the unheated concentrates. The most notable difference in flavor stability was the greater stability of the heat-treated lots as a group over the unheated lots as a group.

In general, unheated lots retained 50% or more cloud after temperature abuses amounting to a cumulative exposure of 24 days at 10° F. during 1 year at 0° F. Some unheated lots retained 50% or more cloud after slow thawing to 20° F. if immediately re-frozen, but no unheated lots retained as much as 50% cloud after thawing to 40° F. under the same conditions.

Most heat-treated lots retained 50% or more cloud after an experience of thawing to 40° F. if immediately re-frozen. They could not, however, retain in excess of 50% cloud on prolonged (1 week) exposure to 40° F. after any of the previous temperature histories. This applied even to lots which retained more than 50% cloud during 1 week at 40° F. when freshly manufactured. In general, heat-treated concentrates retained 50% or more cloud after a cumulative time-temperature history including one thawing to 20° or 40° F. in combination with a total exposure of approximately 24 days at 20° F. during the 1-year storage period.

Although flavor is quite stable in heated concentrates and relatively stable in unheated concentrates, the effects of time-temperature histories on flavor are cumulative. Unfavorable temperature histories, which do not in themselves produce flavor changes, may nevertheless increase the probability of flavor changes

appearing after subsequent temperature abuses. This effect is proportional to the temperature at which abuse occurs. There is also an indication that the flavor changes observed in these studies were the result of enzyme action.

Ascorbic acid (vitamin C) was found to be extremely stable throughout all time-temperature histories employed.

The results indicate that changes in cloud and flavor occurring in frozen concentrated orange juice may be initiated at all temperatures above 0° F.

Acknowledgment

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Action of Phosphates in Sausage Products

II. Pilot Plant Studies of the Effects of Some Phosphates on Binding and Color

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SECOND of a series, the present article is concerned with the action of phosphates in sausage products, such as frankfurters and bologna sausage. The first paper dealt with the results of a laboratory study of factors influencing the moisture retention of lean ground meat containing added phosphates *(2)*. The present paper reports the results of an investigation of the effects of incorporating phosphates in commercial-type frankfurters and bologna sausage.

The marked interest recently displayed by the sausage industry in employing phosphate additives stems from recognition of the possibility that production methods or quality, or both, may be improved. Primarily, there is interest in improving the "binding" of meats to improve certain of the physical characteristics of sausage products and to permit wider latitude in utilizing both meats and processes. One object is to improve the utilization of raw materials naturally lacking in ability to bind. Another is to reduce tendencies towards separation and breakdown of products, a consideration of special importance in operating smokehouses at the relatively high temperatures necessary in rapid smoking and curing. The elimination of some of the risk involved in rapid smoking and cooking can, in effect, increase the capacity of smokehouse facilities. In addition, there is considerable interest in improving color.

The ability of phosphates to produce the effects mentioned has previously been both supported and denied, as was indicated in the review of literature included in the first paper of this series *(2)*. Recognition of the limited usefulness of information available on this subject led to the investigation here described. The investigation included a study of some effects on the binding and color of sausage produced by the usual curing agents, and by adding a limited number of phosphates. Emphasis was also given to determining the influence of processing conditions.

EXPERIMENTAL AND RESULTS

Sausage-making: Generally, in each experiment a series of from 3 to 5 batches of sausage was prepared. The batches of each series were cured with different chemical agents or combinations of them, but otherwise, they were formulated from the same freshly prepared lots of meat. The different kinds of meat employed were prepared as follows:

Steer beef was separated from carcasses stored at 37° F. (2.8° C.) for 3–7 days after slaughter. The meat was wrapped in cellophane and placed in boxes holding 25 or 50 pounds. These were stored at 0° F. (−17.8° C.). Frozen lean beef was allowed to thaw and was ground, first through a one-inch plate and then through a ⅛th-inch plate.

The pork used in preparing Series 3 to 5 was obtained by boning-out entire hog carcasses. It was separated into distinctly lean and all-fat portions which were ground through ⅜ths- and one-inch plates, respectively. Lean pork trimmings, which had been ground through a one-inch plate, were used in preparing Series 6 to 12.

Each lot of ground meat was thoroughly mixed and divided into the portions required in formulating the batches comprising a series. Data relative to the meat and ice used in the preparation of each of the 12 series are given in Table 1.

TABLE 1

Weights of meat and ice used in preparing batches of sausages in Series 1 to 12

Series	Weight of meat per batch		Weight of ice per batch
	Beef	Pork[1]	
	lb.	*lb.*	*lb.*
1 and 2	20	....	5
3	24	10L, 15F	15
4 and 5	25	10L, 15F	15
6, 7, 8, 9, and 10	25	25T	16
11	12.5	12.5T	7
12	25	25T	16

[1] Letters L, F, and T designate pork lean, fat, and trimmings (regular), respectively.

All sausages, except those in Series 1 and 2 which contained only single curing agents, were cured with a mixture of sodium chloride, sodium nitrite, sodium nitrate, and sugar in the proportion of 2 pounds (908 g.) of sodium chloride, 2 ounces (56.8 g.) of analytical grade sodium nitrate, ¼th ounce (7.1 g.) of C. P. sodium nitrite, and 4 ounces (113.6 g.) of cane sugar per 100 pounds of meat. A commercially prepared spice mixture, containing dextrose, cardamon, and white, black and red pepper, was used in the proportion of 6½ ounces (184.4 g.) per 100 pounds of meat in the preparation of batches in Series 3 to 12. Food grade phosphates in powdered form were used in the proportion of 8 ounces (226.9 g.) per 100 pounds of meat. Those added were sodium hexametaphosphate (SHP), a commercial preparation containing pyrophosphates and an orthophosphate, and combinations containing two or more of the phosphates sodium hexametaphosphate (SHP), tetrasodium- and disodium acid pyrophosphates (TSPP and SAPP, respectively), and potassium polymetaphosphate (KPP). These phosphates are principal constituents of a number of proprietary phosphate preparations. In addition to phosphates, the commercial preparation contained at least one organic acid. All curing agents, phosphates, and spices were added in dry, finely ground form to the ground meat immediately prior to the preparation of meat emulsions in the silent cutter.

Comminuting, mixing, and stuffing were done with a grinder, silent cutter, mixer, and stuffer of small commercial size

capable of handling approximately 60-pound batches. The batches comprising a series were chopped and stuffed in succession, with only a few minutes intervening during which equipment was cleaned. Bologna was stuffed into Visking[a] cellulose, 2¾ x 22-inch "high stretch", and frankfurters into Visking[a] 27/32nd-inch NOJAX[a] casings. In preparation for smoking and cooking the batches or lots comprising each series, the individual bologna or short strings of frankfurters were distributed by a plan of randomization on smoke sticks which were placed on the same horizontal level on the sausage cage or truck. The bologna in Series 1 to 5 were smoked and cooked in a brick, steam-heated house equipped with an automatic smoker. An air-conditioned smokehouse of modern design was used in smoking and cooking Series 6 to 12. The products were cooked (finished) in the smokehouse by heating them to obtain an internal temperature of 150° F. (65.6° C.), except that those in Series 10, or those reheated in Series 8, were heated to obtain an internal temperature of 160° F. (71.1° C.).

Methods: Color values were determined by the method of Ramsbottom *(1)* with a Beckmann Model DU[a] spectrophotometer equipped with a reflectance atachment. This method involves determining the ratio of the reflectance of a sample measured at 650 mμ with that measured at 570 mμ; the ratio is the "color value". Samples were obtained for color determinations by removing a portion of the inside of the sausage with a cork borer (15 mm. diam.). The cores obtained were ground through an ordinary meat grinder equipped with a medium-sized plate, after which the ground meat was mixed and then firmly pressed into a cup (10 mm. depth, 30 mm. width) which fitted into the reflectance attachment. Samples of bologna were removed from slices cut from the approximate center of the sausages, and the color value of the freshly cut surface was determined. Each of the color values reported for the fifteen batches comprising Series 6 to 9 represents the mean of 3 values determined on different samples obtained from each batch. The color values reported for the frankfurters in the different lots of Series 11 to 12 represent the mean of values obtained on samples from 10 different frankfurters from each lot.

Determination of tensile strength—a measure of cohesiveness—and the moisture losses produced during smoking and cooking operations, were used as indices of binding. This was consistent with the generally accepted conception of binding as involving the cohesion of components and indirectly, if not directly, the retention of moisture. The tensile strength of samples of bologna was determined with an apparatus constructed mainly of wood having the appearance and the critical dimensions shown in Figure 1.[b] The method of measuring tensile strength was as follows: The center section of bologna was sliced in a U. S. Slicing Machine[a] into 0.138-inch (3.5 mm.) thick slices. Every seventh slice was selected for testing. A strip 0.875-inch (22.2 mm.) in width and approximately 4 inches (102 mm.) in length was cut from each of these slices with a scalpel. The strip was firmly clamped on the apparatus and stretched until broken by increasing pressure applied by the addition of sand to a beaker placed as shown in the illustration. The sand was added at a uniform rate through a funnel, a two-inch length of rubber tubing and a clamp being attached to the stem to permit control of flow. The weights of beaker and sand, in grams, at the breaking point of strips from five slices of a bologna representing each batch were determined. From these data, mean tensile strength values were calculated.

pH values were determined on slurries prepared by comminuting 50 g. portions of sausage with 100-ml. volumes of distilled water.

[a] The use of trade names in this paper is for identification only and does not constitute endorsement of the products.

[b] The instrument was devised to test binding by N. G. Barbella and O. G. Hankins (deceased), who were associated with this laboratory when it was part of the former Meat Office of the Animal Husbandry Division, Bureau of Animal Industry, USDA. It is illustrated here with the consent of Mr. Barbella.

To determine the shrinkage of the bologna of Series 6, 7, 8, and 9, the weights of the bologna comprising each batch were individually determined before and after smoking and cooking. The mean moisture loss, or shrinkage, of the bologna in each series, calculated and expressed as a percentage of the weight of the unheated bologna, is reported. The shrinkage of the all-beef products in Series 1 and 2 was obtained by weighing the entire batches before and after smoking and cooking.

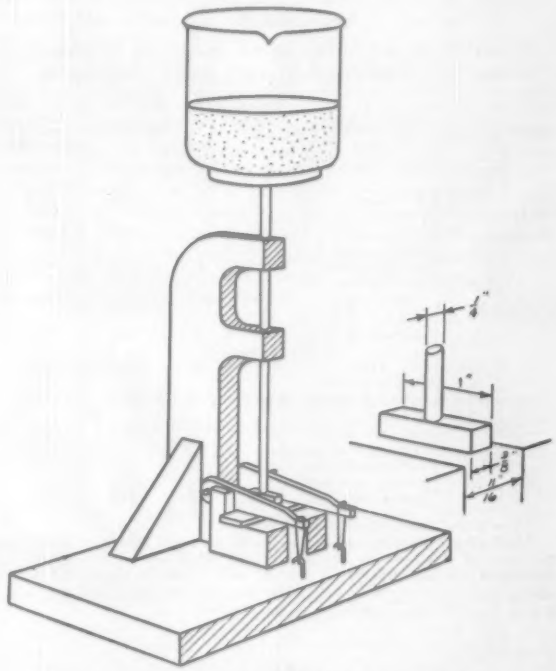

Figure 1. Apparatus employed in determining the tensile strength of strips of bologna.

Preparation, composition, processing, and properties of sausage of Series 1-12. *Series 1 and 2.* Two series, each consisting of five 20-pound batches of all-beef sausage, were prepared to study the effect of individual customary curing agents on the heating of meat during chopping and on binding. The 5 batches in Series 1 included one prepared without curing agents, and others cured only with sodium chloride, sodium nitrate, sodium nitrite, or sugar. The concentrations employed were in the range of those customarily used in sausage formulas. The 5 batches in Series 2 included one prepared without curing agents, and batches cured only with sodium chloride added at the levels of 1.5, 3.0, 4.5, and 6.0-pounds of sodium chloride per 100 pounds of meat. Data on temperatures attained by meat emulsions during comminution, shrinkage of sausage during smoking and cooking, and the tensile strength values of samples of the products, are shown in Table 2.

Series 3, 4, and 5. Three series, each consisting of either 3 or 4 batches of bologna, were prepared during an investigation of the effect of phosphates on binding, and the temperatures of emulsions undergoing comminution. One batch in each series was cured only with the curing mixture; the others contained, in addition, different mixtures of phosphates. The mixtures employed included one of 25% sodium hexametaphosphate (SHP), 65% tetrasodium pyrophosphate (TSPP), and 10% sodium acid pyrophosphate (SAPP) (Series 3 and 4); another of 25% potassium polymetaphosphate (KPP), 65% tetrasodium pyrophosphate (TSPP), and 10% sodium acid pyrophosphate (SAPP) (Series 5); and another which was a com-

mercial preparation (Series 3, 4, and 5). The weights of meat and ice used per batch in preparing the 3 series are shown in Table 1. Information obtained on the composition, processing, and properties of the bologna is given in Table 3.

Series 6, 7, 8, and 9. Four series, each of which consisted of three or more approximately 60-pound batches (each yielding eight approximately 7-pounds bolognas per batch) of bologna were prepared in an investigation of the effect of phosphates on the shrinkage and color of normally processed bologna and the shrinkage of bologna subjected to unusual heating. The weights of meat and ice used in preparing each batch are shown in Table 1. Each series consisted of a batch cured only with the curing mixture, and others cured with this mixture plus either the commercial phosphate mixture, a mixture composed of 70% tetrasodium- (TSPP) and 30% sodium acid- (SAPP) pyrophosphates o sodium hexametaphosphate (SHP). The stuffed sausages in each series were held overnight and were then smoked and cooked to an internal temperature of 150° F. (65.6° C.) which required approximately 5 hours. The color and pH values of the products were determined and data on shrinkage were obtained. The bologna in Series 8 were reheated to produce a final internal temperature of 160° F. (71.1° C.), and the bologna were again weighed to obtain data on shrinkage during the second heating. A variation of the procedure of smoking and cooking was used in preparing the batches of Series 9. Four of the bologna representing each batch were smoked and cooked to an internal temperature of 150° F. in 3 hours and 50 minutes and four others were smoked and cooked to this same internal temperature in 7 hours. A summary of the results showing the pH, the mean color values, and the mean shrinkage of the bologna in the four series is presented in Table 4.

TABLE 2

Effects of ordinary curing agents on binding of all-beef sausage and emulsion temperatures during comminution

Series	Batch number	Curing agents per 100 lb. meat	Comminution		Shrinkage	Mean tensile strength[2]
			Temperature[1]	Time		
			° F.	Min.	%	g.
1	1	none	55.0	8	11.2	365
	2	7.09 g. (¼ oz.) sodium nitrite	53.5	8	11.2	365
	3	56.7 g. (2 oz.) sodium nitrate	56.5	8	10.4	350
	4	113.5 g. (4 oz.) cane sugar	55.0	8	11.0	340
	5	908.0 g. (2 lb.) sodium chloride	62.5	8	9.7	960
2	1	none	55.0	10	14.0	425
	2	681.0 g. (1.5 lb.) sodium chloride	55.0	7	13.0	695
	3	1362 g. (3.0 lb.) sodium chloride	55.0	7	10.9	1200
	4	2043 g. (4.5 lb.) sodium chloride	55.0	7	10.3	1300
	5	2724 g. (6.0 lb.) sodium chloride	55.0	7	11.0	1390

[1] The initial temperature was 32° F.

[2] Differences between the mean tensile strength values of Batch 5 and those of Batches 1–4 (Series 1) were significant at the 1% level; differences between Batches 1 and 2, and 2 and 3 (Series 2) were significant at the 5% level; and those between Batches 1 and 3, 1 and 4, and 1 and 5 were significant at the 1% level.

TABLE 3

Effects of phosphates on binding in bologna and emulsion temperatures during comminution

Series	Batch number	Phosphate added, 0.5%	Comminution		Mean tensile strength[1]
			Time	Temperature at completion	
			Min.	° F.	g.
3	1	None	12	60	430
	2	25% SHP, 65% TSPP, 10% SAPP	12	49	740
	3	Commercial	12	50	715
4	1	None	12	56	460
	2	25% SHP, 65% TSPP, 10% SAPP	17	56	615
	3	Commercial	17	56	620
	4	25% KPP, 65% TSPP, 10% SAPP	17	56	635
5	1	None	10	56	390
	2	Commercial	13	56	690
	3	25% KPP, 65% TSPP, 10% SAPP	13	56	630

[1] In each series the differences between the mean tensile strength values of samples of batches prepared with and without phosphates was significant at the 1% level.

TABLE 4

Effect of phosphates on the shrinkage and color of bologna

Series	Batch number	Phosphate added	pH	Mean color value	Mean shrinkage[1]	
					Heated to 150° F.[2]	Heated to 160° F.
					%	%
6	1	None	6.15	2.30	4.92	.....
	2	Commercial	6.35	2.41	4.94	.....
	3	70% TSPP–30 % SAPP	6.20	2.33	4.98	.....
7	1	None	6.30	2.42	3.32	.....
	2	Commercial	6.50	2.44	3.29	.....
	3	70% TSPP–30 % SAPP	6.40	2.48	3.39	.....
8	1	None	6.15	2.37	6.83	2.23[3]
	2	Commercial	6.30	2.42	6.96	1.85
	3	70% TSPP–30 % SAPP	6.25	2.37	6.95	1.94
9	1_s[4]	None	6.15	2.13	5.43	.....
	1_r	None	6.15	2.10	5.17	.....
	2_s	70% TSPP–30 % SAPP	6.20	2.11	5.64	.....
	2_r	70% TSPP–30 % SAPP	6.20	2.11	5.17	.....
	3_s	SHP	6.10	2.05	5.69	.....
	3_r	SHP	6.10	2.09	5.17	.....

[1] Mean shrinkage of 8 bologna, except that means of bologna in Series 9 were based on 4 bologna.

[2] Differences between mean shrinkage of batches comprising each of the Series 6–9 were not significant; the difference between the mean shrinkage of the group of batches 1_s, 2_s, and 3_s and that of the group of batches 1_r, 2_r, and 3_r, 5.59 and 5.13% respectively, of Series 9 was significant at the 1% level.

[3] Differences between the mean shrinkage of Batch 1 and 2, 0.38% and Batches 1 and 3, 0.29%, respectively, of Series 8 exceeded 0.22 and 0.25%, respectively, required for significance at the 1% level.

[4] 1_s, 2_s, and 3_s smoked and cooked in 7 hours; 1_r, 2_r, and 3_r smoked and cooked in 3½ hours.

Series 10. This series also was prepared in investigating the effects of phosphates on binding. A batch cured only with the curing mixture and another with, in addition, a mixture consisting of 25% sodium hexametaphosphate (SHP), 65% tetrasodium- (TSPP), and 10% sodium acid- (SAPP) pyrophosphates were prepared. The weights of meat and ice used are shown in Table 1. Both batches were smoked and cooked until an internal temperature of 160° F. was obtained. A photograph of representative samples of the batches is shown in Figure 2.

Series 11 and 12. These series were prepared in an investigation of the effect of some of the phosphates on the color of frankfurters, with emphasis being given to determining the effect of varying the rate of heating during smoking and cooking operations.

Series 11 consisted of 3 batches, each of which was prepared from the weights of meat and ice shown in Table 1. One batch was cured only with the ordinary cure (Treatment 1), while the other two were cured with, in addition, either the commercial phosphate mixture (Treatment 2), or a mixture com-

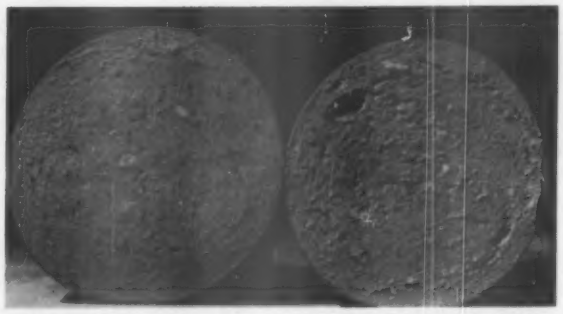

Figure 2. Representative samples of batches of bologna containing, left, 0.5% by weight of a phosphate mixture (consisting of 25% sodium hexametaphosphate, 65% tetrasodium- and 10% sodium acid pyrophosphates) and, right, no phosphate.

posed of 70% tetrasodium- (TSPP) and 30% sodium acid- (SAPP) pyrophosphates (Treatment 3). Each batch of frankfurters, after stuffing, was separated into three approximately equal portions and one of these was placed in each of 3 lots, designated as Lots a, b, and c. Lot a, after storage for approximately 45 minutes at room temperature, was smoked and cooked in 98 minutes; Lot b, after storage for approximately 160 minutes at room temperature, was smoked and cooked for 113 minutes; and Lot c, after over-night storage (approximately 20 hours) at 37° F. (2.7° C.), was smoked and cooked in 43 minutes. The color and pH values of samples of the frankfurters were determined. Data showing the means of these values and the results of a statistical analysis of differences in color values are shown in Table 5.

The preparation of Series 12 was begun by producing a single batch of meat emulsion from materials which included 25, 25, and 16 pounds of lean beef, pork trimmings, and ice, respectively. This large batch was chopped in the silent cutter until a temperature of only 40° F. (4.4° C.) was obtained, after which it was separated into five 13.2-pound portions. To each of four of the portions a different phosphate, or phosphate mixture, was added, the additive being 70 and 30% (Treatment 2), and 90 and 10% (Treatment 3) of tetrasodium- (TSPP) and sodium acid (SAPP) pyrophosphates, respectively, sodium hexametaphosphate (SHP) (Treatment 4), and the commercial mixture (Treatment 5). Each portion was returned to the silent cutter and further chopped until the emulsion attained a temperature of 56° F. (13.3° C.). After the portions were stuffed into casings, half was held for approximately 10 minutes at room temperature and then smoked and cooked in 50 minutes (Lot a), and half was held for approximately 90 minutes and then smoked and cooked in 100 minutes (Lot b). Mean color and pH values were determined. These results and the results of a statistical analysis of difference in color values are shown in Table 5.

DISCUSSION

Effects of ordinary curing agents. Data presented in Table 2 show the effects of ordinary curing agents added individually at customary levels to all-beef

TABLE 5

Effect of phosphates and processing variables on the color of frankfurters

Series	Lot	Processing time			Treatment		Color				pH of product
		Tempering		Smoking and cooking	No.	Phosphate	Mean of 10 values	Relation to other treatments			
		Before stuffing	After stuffing					Comparison of means	Differences		
									Found	Req. for significance	
		Min.	*Min.*	*Min.*							
11	a	45	45	98	1	None	2.093	>2[1]	0.038	0.0365	6.10
						Commercial	2.055	>3[1]	0.175	0.0531	
					2			>3[1]	0.137	0.0327	6.25
					3	80% TSPP–20% SAPP	1.918				6.30
	b	45	160	113	1	None	2.123	>2	0.033	0.0428	6.10
								>3	0.035	0.0462	
					2	Commercial	2.090	>3	0.002	0.0496	6.25
					3	80% TSPP–20% SAPP	2.088				6.30
	c	45	1200	43	1	None	2.069	<2	0.037	0.0380	6.10
								>3	0.033	0.0544	
					2	Commercial	2.106	>3[1]	0.070	0.0533	6.25
					3	80% TSPP–20% SAPP	2.036				6.30
12	a	60	10	50	1	None	2.181	>2[1]	0.310	0.0609	6.0
								>3[1]	0.288	0.0530	
								>4[1]	0.113	0.0661	
								>5	0.056	0.0730	
					2	70% TSPP–30% SAPP	1.871	<3	0.018	0.0495	6.15
								<4[1]	0.197	0.0610	
								<5[1]	0.354	0.0688	
					3	90% TSPP–10% SAPP	1.893	<4[1]	0.175	0.0567	6.25
								<5[1]	0.332	0.0642	
					4	SHP	2.068	<5	0.057	0.0756	6.0
					5	Commercial	2.125				6.20
	b	60	90	100	1	None	2.339	<2[1]	0.120	0.0698	6.0
								<3	0.028	0.1010	
								<4[1]	0.107	0.0917	
								<5	0.017	0.0848	
					2	70% TSPP–30% SAPP	2.459	>3	0.092	0.1260	6.15
								>4	0.013	0.0964	
								>5[1]	0.103	0.0902	
					3	90% TSPP–10% SAPP	2.367	<4	0.079	0.1218	6.25
								>5	0.011	0.1159	
					4	SHP	2.446	>5	0.090	0.1070	6.0
					5	Commercial	2.356				6.20

[1] Denotes significance at the 5% level.

sausage on the development of heat during comminution, the retention of moisture during smoking and cooking, and cohesiveness, as indicated by tensile strength values. Only the addition of sodium chloride appreciably affected these properties. It increased both cohesiveness and the retention of moisture and was responsible for the development of heat during comminution. Markedly increased tensile strength values were obtained on increasing concentrations of sodium chloride from 0 to approximately 3%; further increases of concentration to approximately 4.5 to 6% produced smaller effects which were not significant.

Effects of phosphates on time-temperature relations in chopping and on tensile strength. As shown in Table 3, the addition of each of three combinations of phosphates considerably modified the action of the curing mixture. The data show that the tensile strength, or cohesiveness, of the bologna containing added phosphates was significantly greater than that of bologna cured only with ordinary curing agents. Also, it is evident that the rate at which the temperature of emulsions increased during comminution in the silent cutter was markedly less in the presence of the phosphates tested. This difference was such that the temperature of emulsions prepared with and without phosphates differed by as much as 11° F. (6.1° C.) after 12 minutes of chopping (Series 3). Owing to this same effect, phosphate-treated batches were chopped as much as 5 minutes more than batches containing no phosphates, when the batches in Series 4 and 5 were comminuted until the emulsions attained a temperature of 56° F. (13.3° C.).

Binding of moisture. The results presented in Table 4 indicate that the inclusion in the formulas of bologna of either the commercial phosphate, a mixture of 70% tetrasodium pyrophosphate (TSPP)—30% sodium acid pyrophosphate (SAPP), or of sodium hexametaphosphate (SHP), had no significant effect on moisture losses, or shrinkage, when the sausages were smoked and cooked to a maximum internal temperature of 150° F. (65.6° C.). Results of a statistical analysis based on the data indicated that differences between the mean shrinkage of treatments as small as 0.20–0.31% would have been significant under the conditions employed. Thus, on preparing bologna from meats capable of yielding well-bound products and heat-processing these products to obtain a maximum internal temperature which lies in the range considered normal and desirable, the addition of phosphates produced no significant effect on shrinkage. These results support in part the conclusions of Wilson *(3)*.

In contrast, bologna containing added phosphates shrunk significantly less than bologna treated only with normal curing agents, when the bologna in Series 8 were heated to the higher maximum internal temperature of 160° F. (71.1° C.). A photograph (Figure 2) of cross-sections of two bologna from lots processed in Series 10, both of which had been heated to a maximum internal temperature of 160° F., shows that, under these conditions, phosphate-treated bologna (sample at left) had a normal appearance, whereas bologna containing no phosphate-additive (sample at right) had a poor physical structure.

The detrimental effect on binding of overheating sausage is well-known in the industry *(4)*; consequently, heating to internal temperatures much in excess of 150° F. is avoided. A basis for assuming that the addition of phosphates would reduce shrinkage in products heated to 160° F. was provided in previously reported results *(2)*. The earlier results indicated that evaporation was reduced by the addition of phosphates to ground lean meat and water mixed in the proportion 2:1. Samples in these experiments were heated for 2 hours in an oven held at 167° F. (75° C.). The present results indicate that a reduction of shrinkage due to evaporation occurred in a commercial-type product only when the products were heated to an extent normally considered excessive. While the experimental condition of heating the center of products to an internal temperature of 160° F. is seldom realized commercially, heating external portions to this or greater temperatures is to be expected when high temperatures are applied to achieve rapid smoking and cooking. The results are consistent with the conclusion that the use of phosphates increases binding and that their use can be of value in efforts to decrease the time required in smoking and cooking. Calculations were made on the shrinkage of the bologna in the slowly heated and rapidly heated batches in Series 9. It was found that 0.46%, the difference between 5.13 and 5.59%, the means of the shrinkage of the bologna in the rapidly heat-processed group (Batches 1_r, 2_r, and 3_r) and the slowly heat-processed group (Batches 1_s, 2_s, and 3_s), respectively, was significant at the 1% level. This result supports the belief advanced by some sausage technicians that rapid heat processing decreases moisture losses, or smokehouse shrinkage.

Color development. The differences between the mean color values of bologna in batches of each of the series comprising Series 6–9 were not significant. Interpreted in the light of the results obtained in the studies of the development of color in frankfurters which are described in the following paragraphs, this result suggests that any tendency of phosphate treatments to influence the development of cured meat color was minimized or eliminated owing to the relatively slow process involved in smoking and cooking bologna.

In contrast, the data presented in Table 5 indicate that the relative effect on color of adding phosphates to frankfurters was marked in some cases, and that the effect was appreciably influenced by varying time and temperature during processing. This is indicated by the different order of effectiveness of the three treatments applied in Series 11, when the frankfurters were processed differently in Lots a, b, and c. The results show that the frankfurters prepared without phosphates (Treatment 1) had a higher mean color value than that of frankfurters treated with either

commercial or pyro-mixtures of phosphates (Treatments 2 and 3, respectively), when smoking and cooking the sausages was begun approximately 45 minutes after stuffing, and finished in 98 minutes (Lot a). This difference was significant at the 5% level. On the other hand, there were no significant differences between the mean color values of frankfurters given Treatment 1 and those given Treatments 2 and 3, when the frankfurters were either smoked and cooked 140 minutes after stuffing, and finished more slowly in 113 minutes (Lot b), or stored over-night (1200 minutes) and then smoked and cooked quickly in 43 minutes (Lot c).

Varying the processing of the frankfurters in Series 12, by providing two sets of conditions of tempering, smoking, and cooking, markedly changed the relative order of the effect of five different treatments on color development. The data indicate that there were appreciable differences between mean color values of five batches of frankfurters, which had different treatments and then were rapidly smoked and cooked in 50 minutes (Lot a). The numbers of the treatments, arranged in order of decreasing effectiveness as indicated by mean color values, were as follows: Treatments 1, 5, 4, 3, and 2. The differences between the mean color value of frankfurters prepared without added phosphates (Treatment 1) in Lot a were greater (significant at the 5% level) than the mean color values of phosphate-treated frankfurters, except that it was not significantly different from the mean color value of frankfurters treated with the commercial phosphate mixture (Treatment 5). The difference between the mean color values of frankfurters containing the commercial phosphate (Treatment 5) and those of frankfurters containing either of the two mixtures of pyrophosphates (Treatments 2 and 3); and those between the color values of frankfurters containing sodium hexametaphosphate (Treatment 4) and the color values of frankfurters containing either of the two mixtures of pyrophosphates (Treatment 2 and 3) were also found to be significant.

The data indicate that color developed more completely in the more slowly smoked and cooked frankfurters in Lot b than it did in those more rapidly heat-processed in Lot a. Even more striking, the relative order of effectiveness of the various treatments on color development was markedly changed. The treatments of bologna processed in Lot b, arranged according to treatment numbers and in order of the decreasing mean color values of the frankfurters produced by the treatments, were as follows: Treatment Nos. 2, 4, 3, 5, and 1. The differences between the color value of frankfurters containing 70% tetrasodium—30% sodium acid pyrophosphates (Treatment 2) and those of frankfurters containing no phosphate (Treatment 1), or of frankfurters containing the commercial mixture (Treatment 5) were significant. The difference between the mean color values of frankfurters containing sodium hexametaphosphate (Treatment 4) and frankfurters containing no phosphate (Treatment 1) was also significant.

The results in the foregoing indicate that the development of color in frankfurters prepared without added phosphates was greater than that in frankfurters containing phosphates when processing involved brief tempering and relatively rapid smoking and cooking. The apparent inhibition of color development by the phosphates disappeared when additional time for tempering and smoking and cooking was provided. In fact, the relative effect of treatments was reversed, and the color developed in frankfurters treated with sodium hexametaphosphate and others treated with 70% tetrasodium—30% sodium acid pyrophosphates was significantly greater than the color of frankfurters containing no phosphate when the additional time was allowed for color development. While the color of frankfurters containing the added commercial mixture was equal to that of frankfurters containing no phosphates under both sets of processing conditions (Lots a and b), the organic compound which the commercial mixture contained is assumed to have influenced color, modifying the action of those phosphates of which it was composed. Inasmuch as the results obtained with the phosphates studied indicate that the development of maximum color may constitute a problem in rapidly smoking and cooking frankfurters, the incorporation in formulas of an additional additive, such as ascorbic acid which favorably affects color development, may be advisable when a rapid smoking and cooking operation is attempted.

In view of the variance of the effects of the phosphates on shrinkage and on color development, depending on processing conditions, it appears reasonable to assume that at least some of the past confusion in the literature and in the industry concerning the action and value of the phosphate additives has resulted from a lack of appreciation of the role of processing variables. Having presented data on these effects, the present results appear to afford a basis for an improved evaluation and more rational use of phosphates in sausage-making.

SUMMARY

An investigation was conducted of the effects of ordinary curing agents and of certain phosphates employed under varied conditions on the color and binding of frankfurters and bologna. Shrinkage during smoking and cooking and cohesiveness as indicated by tensile strength measurements were employed as criteria of binding. The results of an investigation of the effect of the customary curing agents, sodium chloride, sodium nitrite, sodium nitrate, and sugar applied singly showed that only the action of sodium chloride markedly enhanced the development of heat when emulsions were prepared, the retention of moisture during heat processing, and the cohesion of meat.

The addition of three combinations of phosphates markedly increased the relative binding of sausage components, as indicated by the effect of the additives

in increasing the tensile strength, or cohesion of meat, in samples of bologna. The relative shrinkage of bologna smoked and cooked to an internal temperature lying within the range normally used in the industry was not affected by the addition of three combinations of phosphates. However, the shrinkage of bologna heated to an internal temperature of 160° F. was decreased by the action of the two combinations of phosphates which appeared to stabilize the products heated to this temperature.

Data were obtained showing that the rate at which the temperature of emulsions increased during comminution was markedly reduced in the presence of certain phosphates tested.

The results indicated that the phosphates tested tended to inhibit color development in rapidly processed frankfurters, but not in normally processed frankfurters or in bologna heat-processed at either rapid or normal rates. The color developed on addition of one phosphate and one combination of phosphates to frankfurters was superior to that obtained with ordinary cure in products heat-processed at a normal rate. Thus, depending on the length of the period allowed for color development during tempering and during smoking and cooking, the phosphate-treated frankfurters that were prepared had less, equal, or more color than frankfurters containing no added phosphates.

The results afford a basis for explaining previous contradictions and confusion regarding the merits of phosphate-additives in sausage by showing that the action of the additives was affected by processing variables.

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Notes and Letters

Journal Article Standards — Can They Be Defined?*

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EVERYONE who is concerned in any way with a particular scientific journal, i.e. its subscribers, its contributors, its editors, its advertisers (if any), and the society which sponsors it, shares a common interest in it: to maintain the highest standards of quality in the selection of its subject matter content. Upon achievement of this, rest ultimately the reputation and success of the journal, the good name of its editors, and to some extent even, the prestige of the society.

While maintaining standards for journal articles suggests itself easily therefore as a most worthy goal, the problem of defining them in terms applicable to the day-to-day duties of an editor is far more difficult. Similarly to other high human aspirations, such as "justice" or "morality," journal article standards constitute, a somewhat intangible and ethereal objective, distinguishable by the purity and virute of its concept but often a trifle too nebulous to make for easy reference when applied to individual situations.

Four of FOOD TECHNOLOGY'S Associate Editors pause for a candid shot by C. Hamilton Kenney, also an Associate Editor of FT. Left to right: Dr. Georg Borgstrom, Dr. G. E. Livingston (the author of the accompanying article), Dr. Frank A. Lee, and Dr. Harold A. Campbell.

Yet, the duty of the reviewer and the editors to uphold the "standards" of the journal, by maintaining the high quality of individual contributions, is a very real one, and the interpretation of quality standards thus becomes a purely personal and subjective reaction. How else could one explain a very great divergence in opinions occasionally expressed in reviews submitted by equally competent scientists commenting on the same manuscript?

Most journals, including those of our Institute, offer their contributors a printed guide outlining the manuscript requirements. Sometimes, these guides are hardly more than a set of instructions pertaining to the mechanics of manuscript construction. In other cases, including our own leaflet on "Information and Suggestions to Authors," an attempt is made to sketch also the criteria used in reviewing a manuscript for its suitability for inclusion in our journals. However, due to the inherent difficulty of committing article standards to paper in the form of practical criteria, such guides do not by any means resolve the basic problem of fully defining them.

Two primary factors

There are, of course, two primary quality factors to be considered in evaluating a manuscript for publication: the quality of the paper and the quality of the research reported. It is very definitely the purpose and duty of the reviewer to subject to critical examination both the presentation and investigation upon which it is based.

As food scientists, working in or on the fringes of the food industry, we are of course well aware of the importance of quality control in production. We are familiar with the difficulties encountered in establishing and operating an effective quality control system. Furthermore, we recognize the importance of official commodity grade standards in reducing the concept of "quality" into measurable entities. It would be interesting to determine whether or not the philosophy and methodology employed in attaining quality and grade standards for foods could not similarly be applied to the problem of articles!

The first task would be of course to examine a large number of samples (i.e. papers) and establish a list of attributes and variables. As we have already recognized the existence of two primary quality factors, let us break each one of these down into the subfactors constituting them. Along the way, we might attempt to detect what could constitute the "defects" or "stoppers" in assessing compliance of a manuscript with our journal article "standards".

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[a] Presented at the Meeting of the Editorial Boards, FOOD TECHNOLOGY and FOOD RESEARCH, Seventeenth Annual Meeting, Institute of Food Technologists, Pittsburgh. May 11, 1957.

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A. *Quality Factor No. 1—The Presentation.*

This factor is probably the easier one of the two to define and is already covered in part by existing instructions. Basically, presentation includes these subfactors:

1. *Organization of the Paper:* Usual sequence of Title, Introduction, Experimental Methods, Results, Discussion, Summary, Acknowledgments and Literature Cited.

2. *Style:* Should be proper but not ponderous, impersonal but not contrived, readable but not colloquial. The nomenclature, format, abbreviations and other traditions of the journal should be observed.

3. *Introduction:* Here is where conflict arises! Should the introduction be aimed at the specialists in the area in which the work lies, and merely indicate the point of departure and objectives of the investigation, or should it be intended for the average reader who might need to be taken back several steps further in explaining the underlying motives? Is the reviewer (who presumably is selected for his specialized knowledge of the subject matter area represented by the paper) really a fair judge of the adequacy for the general reader of an introduction and literature review? Should the literature review be looked upon as an instrument for paying due homage to one's antecedents, or should it simply be designed as a means of setting the research reported upon in the proper perspective *vis-à-vis* the prior art in the field? This writer favors the latter.

4. *Experimental Methods:* Two schools of thought are again evident here. The first strives for an experimental section replete with all details of procedures, apparatus, reagents or equipment used. The other, in an equally conscientious and commendable effort to streamline the manuscript, aims for a purely skeletal description of the experimental details. What should be the criteria of adequacy used by the author in writing the paper and by the reviewer in examining it? The rule used by this writer in his reviews of full-fledged articles is that the experimental section should be sufficiently detailed to enable a reasonably qualified scientist who might wish to do so, to duplicate in his own laboratory the work described without recourse to any information other than that contained in the paper and references cited in it. (Lack of compliance with this quality sub-factor constitutes a serious "defect" which downgrades the paper until adequate revision is made.)

5. *Results:* Should be expressed in as clear cut a form as possible, using tables and figures where these may be of value. If figures or curves shown are not the immediate result of the measurements or determinations whose methodology is discussed under Experimental Methods, then the treatment applied to the data (averaging, use of regression equations, correlation factors, etc.) should be fully explained.

6. *Discussion:* Without an adequate discussion, no paper is worthy of publication as an article (note: a "stopper") for if the author who has been most intimately associated with the investigation is incapable of providing the reader with an intelligent interpretation of the results, their validity and their significance in relation to the overall problem, surely no one else will be able to do this for him. The discussion should, naturally, draw the proper inference from the results obtained. There should be a clear line of demarcation between the conclusions validated by the data, and their legitimate speculative implications which might be set forth by an author, in an attempt to provide a broader perspective for his contributions, but which nevertheless are unsubstantiated by his own data.

7. *Summary:* A concise recapitulation of what was done, found and concluded.

8. *Literature Cited:* References listed should be only those actually viewed by the author in his search of the literature. Where a reference is cited which was not consulted in the original form, but was discussed by another author or obtained in the form of an abstract, the reference should credit the source which was actually used.

B. *Quality Factor No. 2—The Investigation.*

The burden of the editors and of the reviewers in evaluating the merits of a contribution is a heavy one, especially when research results are reported. While a review article or a transcript of a lecture may be gauged on the basis of general interest, importance of the speaker or the occasion, novelty of ideas or need for the discussion, etc., nevertheless the opinions expressed are publicly understood to be those of the author. While it is equally well understood that no journal assumes a responsibility for the accuracy of information or validity of opinions presented on its pages, it cannot be denied that the mere act of publication imparts a degree of authority to the work involved. At the very least, the implication exists that the author's efforts have been reviewed by a jury of his peers and not found to be wanting. While a reviewer may be stepping on dangerous grounds while probing into the merits of an investigation, he nonetheless assumes this responsibility when he undertakes to evaluate a manuscript and must therefore discharge it to the best of his ability.

1. *Motivation:* This of course is a sacred cow which we should not even be treading upon! It would be exceedingly helpful, but dangerously naive, to assume that all manuscripts are submitted because of the author's unbounded interest in and devotion to the advancement of science. Unfortunately, there exist, on occasion, other purposes which might prompt the submission of a paper—commercial interest in products studied; desire for public recognition; need for additional publications to be credited to one's *vitae* in striving for promotions; validating the expenditure of research funds; justifying attendance at national meetings where papers are initially presented, etc. While the occurrence of these need not necessarily in-

validate the merits of the paper, the conscientious reviewer must search for the genuine elements of value in a contribution to justify the expense of publishing it and the degree of recognition inherent in the act of publication.

2. *Execution:* Most reviewers are hardly in a position to determine the technical competence of the author to undertake the experiments which were carried out. The reviewer has, therefore, little choice but to assume both the competence and intellectual honesty of the worker whose data he examines. There exist, however, some fertile grounds for criticism, reflecting upon the judgment (and therefore indirectly the competence) of the authors, such as the choice of methods or tools used in the experimental work and their implied limitations. The selection of methods by the author, which in the reviewer's expert opinion, would not provide the accuracy needed to support the conclusions indicated, would be a very serious defect (another "stopper").

3. *Interpretation:* In this area particularly, there is much room for scrutiny of a paper by a reviewer. The ever-increasing usage of statistical analysis for interpreting research data leads one to wonder whether the day might not be near when a reviewer might legitimately demand of an author a statistical treatment of his results (if they lend themselves to such analysis) before approving the paper for publication (a potential "stopper"!). This assumes, however, that both the author and the reviewer possess the necessary background in statistical analysis, which in some instances they probably do not. This problem is an important one, and should be given careful consideration.

FINAL CONSIDERATIONS

Let us turn for a moment to a matter which has been of some concern to this writer. Not too long ago, he had the experience in dealing with a reviewer of finding a paper rated as suitable for FOOD TECHNOLOGY but not for FOOD RESEARCH. This differentiation was made not so much because of the nature of the work, but because of its overall quality, which did not meet, in that reviewer's opinion, the standards of achievements for FOOD RESEARCH. Needless to say, the reviewer was a highly respected and proven investigator in his own right. It is not known how prevalent the viewpoint which he expressed might be at large. If this is anything more than an isolated instance, however, it reflects unfavorably upon the efforts which have been made in educating our colleagues to the respective purposes and roles of our journals. Yet, the distinction has been publicly and clearly made—FOOD RESEARCH concerns itself with the "fundamental" types of food science investigation, while FOOD TECHNOLOGY reports on studies of an "applied" nature, with some overlapping being unavoidable. However, it should be understood by everyone that the standards of quality demanded for contribution to either journal are uniformly high!

To return now to the problem of defining standards generally, it has been shown that grading a manuscript is even more difficult than grading a food product. Quality factors, at least some of which can be measured objectively in foods can only be gauged subjectively when dealing with manuscripts. In conducting subjective evaluations on foods, it is customary to attempt to reduce the chances of errors by using a trained "expert" panel whose individual and collective experience and ability to reproduce their observations have been found to attain a highly significant statistical level.

Does this approach have some merit in it in considering the technique of evaluating manuscripts, a commodity easily as complex and variable as any food? The members of the expert panel are of course the editors and the reviewers. We have pointed to several pitfalls in the selection of the proper reviewer for a given paper. To qualify as an expert, he should have more than an academic knowledge of the topic. Ideally he should have been engaged himself in research on the same problem, for only in this fashion will he have had the specialized background needed to fully understand all the implications of a given investigation. At the same time, he should be sufficiently dispassionate to be able to review the competitive work of a colleague without the slightest lack of objectivity. To reduce the chances of error, at least one second "expert" meeting the same qualifications might well be selected. It has at times been suggested that as a means of attaining perfect objectivity, the author's name and affiliation might be deleted. While there is unquestionably an analogy and a precedent for this in the substitution of a code mark for a label on a sample under examination by a taste panel, this practice if carried over to editorial procedure, might be misinterpreted as a reflection upon the integrity of the reviewers.

When a new food has passed the scrutiny of an expert panel, it is usually submitted to some form of consumer type panel for an indication of its general acceptability. There is another useful analogy for us in this too. If it is assumed that a paper published in our journals should be intelligible, not merely to the few specialists concerned at the moment with the very same problem, but to the reader at large, then one might do well to deliberately appoint as one of the reviewers an individual who could reflect the viewpoint of the general readership.

In spite of what we have said, seriously or facetiously, about possible yardsticks of manuscript quality, the best insurance for raising and maintaining the standards of a journal consists in the careful selection of its reviewers. There is no question in the mind of this writer, that each paper should undergo at least two reviews in addition to editorial scrutiny. At least one of the reviewers should be a recognized leader in the area of investigation under discussion, while the other should be selected to provide the reaction that might be expected from the larger body of average subscribers.

Justice and morality, though they cannot be fully

defined, are nevertheless held to be desirable objectives, which can be safeguarded through the promulgation of codes of laws or ethics, implemented by systems of checks and balances. Our laws, in dealing with journal article standards, should be the few tangible criteria for article evaluation which we already have and may in the future formulate; but the best chance for success lies in the continued use of our "checks and balances," i.e. the unrelenting efforts of honest, competent and devoted reviewers to strive for an ever increasing standard of quality for contributions to our journals.

"Organoleptic" Again

THE NOTE IN FOOD TECHNOLOGY for December 1956 on the use of the word "organoleptic" inspires the table below, which, though by no means completely, indicates that this word turns up more than "sporadically"—and that it shows little "tendency to fall into disuse and be less favored in post-war years." The list (Table 1) includes only publications in which the word "organoleptic" occurs in the title. There are numerous publications in several languages in which it occurs frequently in the text.

Despite its persistence in usage, it is difficult to conceive why "organoleptic" should be preferred to 'sensory'. The latter word is more easily comprehended. However, there is no mistaking the strength of current usage.

Here (Table 1) is a sample of the evidence:

TABLE 1

"Organoleptic"—its context and use in journal article titles in post-war years

Journal	*Volume*	*Page*	*Year*	*Context*
Alimenti prod. agrar, e zoot, agrar	3	307–309	1947	"l'analisi organoletica"
J. Am. Oil Chemists' Soc.	24	291–296	1947	"organoleptic evaluation
J. Am. Oil Chemists' Soc.	28	118–121	1951	"organoleptic identification"
Anal. Chem.	24	503	1952	"organoleptic changes"
Chemistry & Industry	41	278	1949	"organoleptic tests"
Chemistry & Industry	41	567	1949	"organoleptic tests"
Chemistry & Industry	41	709	1949	"organoleptic tests"
Chemistry & Industry	42	77	1950	"organoleptic tests"
Chemistry & Industry	42	93	1950	"organoleptic tests"
Chemistry & Industry	42	112	1950	"organoleptic tests"
C. R. Acad. Agr. de France	42	161	1956	"les propriétés organoleptiques"
Dtsch. Lebensm. Rdsch.	46	8–11	1950	"die organoleptische Prüfung"
Dtsch. Lebensm. Rdsch.	46	138–140	1950	"die organoleptische Prüfung"
Dtsch. Lebensm. Rdsch.	47	244–251	1951	"die organoleptische Bewertung"
Food Manuf.	24	257–261	1949	"organoleptic difference"
Food Research	11	84–94	1946	"organoleptic tests"
Food Research	18	381	1953	"organoleptic rating"
Food Research	18	625–627	1953	"organoleptic tests"
Food Research	19	206–210	1954	"organoleptic difference"
Food Research	20	486	1955	"organoleptic tests"
Food Technol.	3	109	1949	"organoleptic changes"
Food Technol.	4	125	1950	"organoleptic changes"
Food Technol.	4	204–205	1950	"organoleptic evaluation"
Food Technol.	4	277	1950	"organoleptic analysis"
Food Technol.	5	428	1951	"organoleptic tests"
Food Technol.	6	250	1952	"organoleptic testing"
Food Technol.	6	258–264	1952	"organoleptic evaluations"
Food Technol.	10	560	1956	"organoleptic evaluation"
Food Technol.	10	496	1956	"organoleptic studies"
Food Technol.	11	47–49	1957	"organoleptic wine-quality"
Food Technol.	11	51–53	1957	"organoleptic wine-quality"
Kulde	2	95		"organoleptiak bedomningsteknik"
Modern Packaging	25	145	1952	"organoleptic evaluation"
Proc. Am. Soc. Hort.	54	342	1949	"organoleptic evaluation"
J. Soc. Chem. Indus. (London)	68	78–80	1949	"organoleptic tests"
J. Soc. Chem. Indus. (London)	68	128	1949	"organoleptic tests"
Zeitschr. Lebensm. Untersu. Forschg.	89	241	1949	"organoleptic tests"
Proc. Assoc. Southern Agr. Workers, 52nd annual convention, page 133, Thesis, Virginia Polytechnic Inst. 1951				"organoleptic testing"

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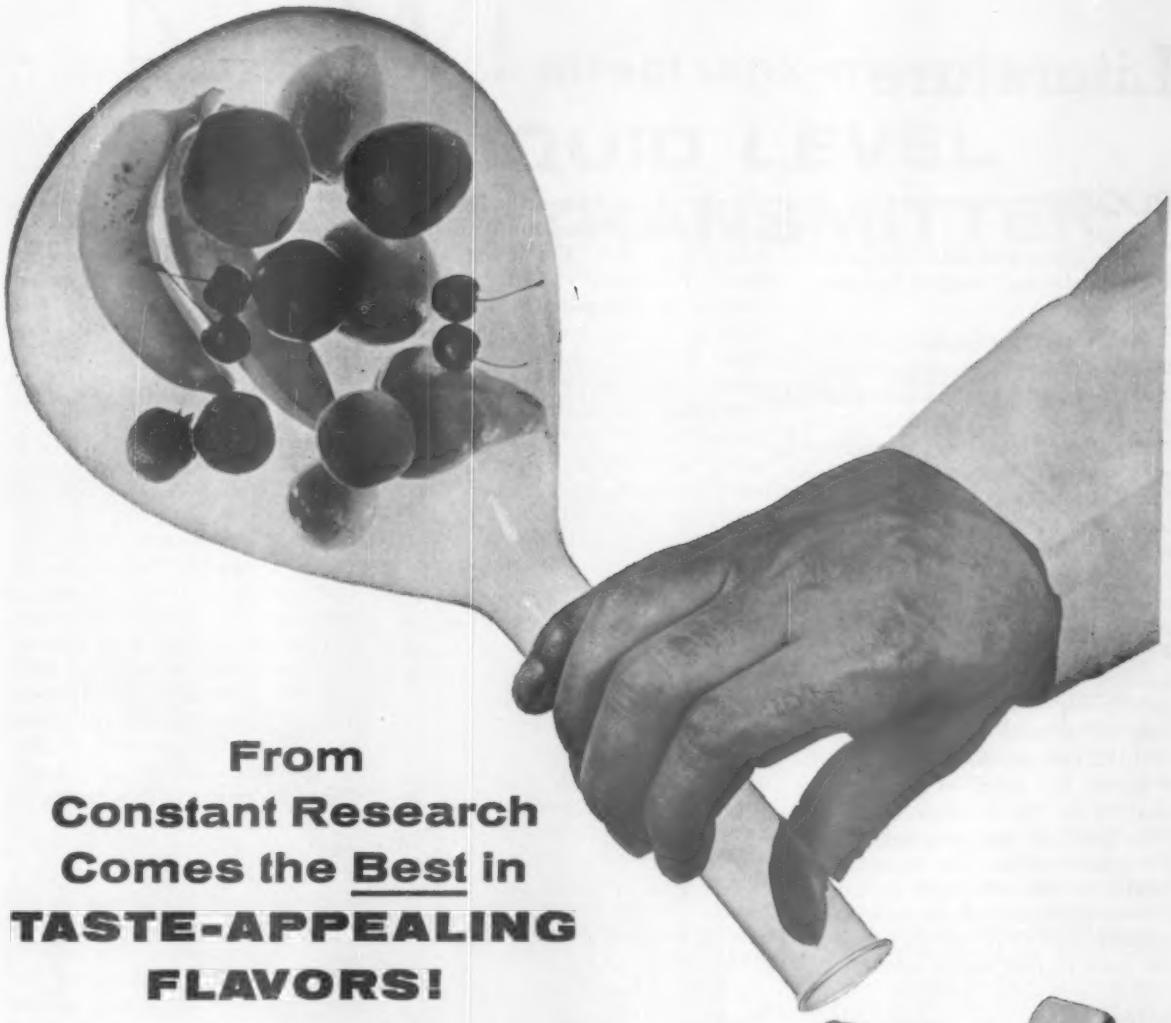

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Literature

BOOKS

FOOD INDUSTRIES MANUAL. Leonard Hill (Books) Limited, London. 1075 pages.

THE FOOD INDUSTRIES MANUAL, 18th Edition, is an encyclopedic dictionary of food terms. The terms are arranged alphabetically in groups under functional categories, such as meat products, canning, dehydration, food handling equipment, and the boiler house. There are 16 chapters—each pertaining to a separate category of functions.

The obvious intention of the compilers, consisting of the staff of *Food Manufacture* and 15 eminent scientists, engineers, and technologists, was to arrange the book so that the searcher for information will be able to find the itemized subjects by going either to the chapter on the category to which the subject is most pertinent or to the subject index. The latter is intended to provide extra guidance to him who may not spontaneously classify a subject categorically in the same manner as the authors.

The arrangers were generally successful in this endeavor although numerous instances could be cited in which the reader would obtain no assistance from the index in locating the definition of a term which he places in a different functional grouping than does the book. He sometimes may find it necessary to search in several chapters before he locates the term he has in mind.

The discussions usually are of elementary type to provide introductions to the various industrial aspects represented by the listed terms. Each definition is couched in words that have special reference to the chapter subject under which it is given and the definition is followed by a description of the pertinence of the term to the division of the food industry under which it is listed. For instance, lecithin is discussed under "Breadmaking and Confectionery" (Chapter 2), "Sugar Confectionery, Chocolate, Jams, and Jellies," (Chapter 3), and "Edible Fats and Fatty Products" (Chapter 9). Dextrin is discussed in its own right in Chapter 1 on "Flour and Flour Milling," also under "Enzymes" in "Bread Making and Confectionery" and under "Adhesives" and "Glues" in "Packaging." Dextrin is only partially indexed and, if one is interested in gums, he must look under "Pickles and Sauces—Stabilizers" to learn that they are discussed on page 336.

Attention is predominantly centered on commodities and, under each functional category (chapter subject) are generally included items under the seven broad aspects of chemistry, biology, processing equipment, processing procedure, ingredients, physical properties, and types of product. Control regulations and production figures also are presented in some chapters. There are a few outstanding chapters in the book; deserving of special mention is the chapter on "The Dairy Industry."

All in all, this book contains a wealth of information on the food industries and makes this information readily accessible. Its defects, in general, are of minor nature. One can always think of many ways in which a book on a subject of great interest to him could be improved. In this case, for instance, more illustrations in such chapters as those on Canning, Dehydration, and Packaging would be helpful. Nevertheless, the book fulfills its purpose admirably. It recites facts with comparatively little delving into theory or the explanation of the facts. After all, it fills more than 1,000 pages without doing that and, in those pages, does a good job of covering advanced food processing and handling practices all over the world. A comprehensive Buyers' Guide, which follows the subject index, of course, is of primary interest only to those in the United Kingdom or, perhaps, to those in the British Empire.

Tables on "Composition of Foods" and "Vitamins in Foods," while not unique, as are some other features of the *Food Industries Manual*, are valuable additions.

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Rutgers University
New Brunswick, N. J.

THE ENCYCLOPEDIA OF CHEMISTRY. George L. Clark, editor-in-chief, Gessner G. Hawley, managing editor, and William A. Hamor, advisory editor. Reinhold Publishing Corporation, New York. 1957.

As the preface to the *Encyclopedia of Chemistry* tells us: "Most scientific books represent at best an approximation of an ideal." The ideal sought in this 1037-page volume was "a reference book *par excellence*, in which the vast range of subject matter is correctly weighed, usefully organized, and concisely presented by experts . . ." To accomplish this task the editors avoided to the extent possible the vocabularies of specialisms and guided the contributions along topical lines. By means of a network of cross-referencing, however, the user can pursue a topic of comparatively broad scope into specialized phases of even the most recent origin. Thus, "colloid chemistry" might well take a food technologist on the prowl for information into the pectins or pectic substances where he would find an economically expressed account of the structure, the occurrence of pectic substances in plant tissues, the properties of pectin and pectic substances, and their importance in food processing. The value of a work of this type to the student attempting to obtain a perspective on *chemistry* as opposed to a *branch of chemistry* is enormous. Scientists in fields allied to chemistry or dependent upon it will also find this book a ready means for ob-

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taining a quick concept of chemical phenomena.

Although the *Encyclopedia of Chemistry* is devoted primarily to giving context to the vocabulary of modern chemistry, it includes succinct information on a score of related fields—for one example, physical testing. Also included are brief accounts of professional societies, research foundations, research centers—such as the Enzyme Institute of the University of Wisconsin—and brief biographies of the great discoverers in the realm of chemistry.

Insofar as scores of specialists, hundreds if not thousands of encyclopedic essays, and a bold plan and a fresh approach can make it so, the *Encyclopedia of Chemistry* "approximates an ideal."

M. S. P.

ABSTRACTS

—Compiled by H. A. Campbell

ANALYTICAL METHODS

The determination of grade strength of pectins by the Teepol-gel procedure.

OLLIVER, M., WADE, P. AND DENT, K. P. (Chivers & Sons, Ltd., Histon, Cambridge). *Analyst 82*, 127–8 (1957).

A provisional standard method for the detn. of grade strength of pectins, described by a sub-committee of the British Food Manufg. Inds., Research Assoc., has been critically examd., and inconsistencies have been found; these can be overcome by suitable modifications. In this modified procedure the pectin soln. is mixed with a detd. quantity of Teepol, or other suitable surface-active agent, before being boiled with sugar and acid to produce a gel of soluble-solids content of 70.5 ± 0.5%. (by refractometer) and a pH of 3.10 ± 0.05 (50% w/w soln. of gel). The gel strength is measured by the Ridgelimeter.

Review of industrial applications of analysis, control, and instrumentation.

Anal. Chem. 29 Part II, 589–734 (1957).

A review of: air pollution, automatic operations in analytical chemistry, clinical chemistry, coatings, essential oils and related products, ferrous metallurgy, fertilizers, food, solid and gaseous fuels, nonferrous metallurgy, pesticides, petroleum, pharmaceutical and related drugs, natural and synthetic rubbers, water analysis.

BIOLOGICAL SCIENCES

Biochemistry

The biosynthesis of pectinic acid methyl esters through transmethylation from methionine.

SATO, C. S., BYERRUM, R. U. AND BALL, C. D. (Michigan State Univ., East Lansing). *J. Biol. Chem. 225*, 717–23 (1957).

Month-old radish plants synthesized radioactive pectinic acid when administered methionine methyl-C^{14}. Over 90% of the radioactivity of the pectinic acid was in the methyl ester carbon.

Immunochemical and physical chemical properties of carboxymethyl proteins.

MAURER, P. H. (Univ. of Pittsburgh Sch. of Med., Pa.). *Arch. Biochem. and Biophys. 67*, 145–53 (1957).

The relative viscosities, optical rotations, and immunochemical properties of the proteins investigated indicate that the carboxymethylation reaction as performed leads to some denaturation of the protein. The immunochemical studies showed not only that the specificity of the CM proteins was different from the native ones but that the introduced CM groupings acted as specific determinants.

Rennet and its effect on the casein of milk.

WISSMANN, H. AND NITSCHMANN, H. (Inst. für organische Chemie der Universität, Bern, Ger.). *Helv. Chim. Acta 40*, 356–63 (1957).

In native α-casein the terminal amino acids were found to be lysine and arginine. In rennin treated α-casein the same endgroups can still be detected, though lysine in smaller quantities. In addn. a new terminal amino acid namely phenylalanine appears in the α-paracasein.

Botany

Plant growth substances.

SALISBURY, F. B. (Dept. of Botany, Colorado Agr. & Mech. Coll.). *Sci. American 196* (4), 125–34 (1957).

Recently plant growth regulators other than auxins have been reported. These include coconut growth factors, kinetin and various unsatd. lactones. These lactones may inhibit cell growth by interfering with certain enzyme systems. Growth regulators other than auxins may have very important applications to the food industry in the near future.

Utilization of lichens in the arctic and subarctic.

LLANO, G. A. (Air Univ., Maxwell AF Base, Alabama). *Econ. Botany 10*, 367–92 (1956).

The principal economic importance of lichens lies in their providing sustenance for hundreds of thousands of reindeer in circumpolar regions, animals upon which the Eskimos, Lapps and other Far North peoples depend for food and clothing. Industrially many of them still furnish raw materials for the dyeing and cosmetic industries, and in past times some of them served for brewing, distilling and medicine. During World War II, the reindeer industry contributed substantially to the Soviet war effort.

Microbiology

Mutual effects of antimicrobial compounds and metallic cations.

WEINBERG, E. D. (Indiana Univ., Bloomington). *Bacteriol. Revs. 21*, 46–68 (1957).

An extensive series of tests was performed to det. the influence of inorganic salts and chelating agents on the ability of the tetracyclines to inhibit microbial growth. Most of the metallic cations that combine chemically with the drugs have no effect on the ability of the tetracyclines to inhibit growth. A few multivalent cations or anions strikingly suppress the activity of the drugs. The suppressing ions vary with the genus of microorganism and to some extent with the medium but not with the kind of tetracycline mol.

Rapid destruction of bacteria in commonly used diluents and its elimination.

STRAKA, R. P. AND STOKES, J. L. (Western Utilization Research Branch, Agr. Research Service, U.S.D.A., Albany, Calif.). *Appl. Microbiol. 5*, 21–5 (1957).

Rapid and extensive destruction of bacteria occurs in the commonly used dilg. fluids, namely distd., tap, and phosphate H_2O, and saline. It is apparent that use of these diluents can lead to large errors in the quant. detn. of bacterial nos. by plating methods. Bacterial losses during diln. can be avoided by the use of peptone H_2O as the diluent. As little as 0.1% peptone is sufficient to provide essentially full protection of bacteria for at least 1 hr. Carbohydates are generally ineffective.

Public health aspects of food poisoning.

WILSON, E., FOTER, M. J. AND LEWIS, K. H. (Robert A Taft Sanitary Eng. Center, Cincinnati, Ohio). *J. Milk Food Technol. 20*, 65–71 (1957).

Despite widespread practice of food sanitation in the United States in recent years, foodborne disease is still prevalent. Better control of the problem is visualized when (a) improved recognition and reporting make possible more effective epidemiological investigations, (b) improved lab. techniques facilitate detection of contaminants in foods, and (c) good sanitation practices in processing, storing, distributing, and serving food are more widely adopted.

Nutrition

Psychologic effects of thiamine restriction and deprivation in normal young men.

How to protect your foods against down-grading by using pure Diamond Crystal Flake Salt

Diamond Crystal *Flake* Salt has the highest uniform purity of any salt made. Ends danger of costly spoilage and "off" flavor from an impure granular salt or rock salt brine. Improves taste and keeping qualities of foods.

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Today's food market is keen. Competitive. The quality of your product is one of your best sales weapons. Why spoil it with an impure salt?

Why flake salt protects quality

Only Diamond Crystal is made by the exclusive Alberger system. This produces flake salt 99.95% pure. An amazing high purity that gives Diamond Crystal *true salt flavor* . . . without the bitter taste imparted by calcium and magnesium compounds, present in less pure salt. By using Diamond Crystal Flake you can *salt to the limit* for optimum flavor.

Diamond Crystal Flake averages less than 1.5 parts per million of copper or iron. Helps prevent oxidative rancidity and off-flavor development.

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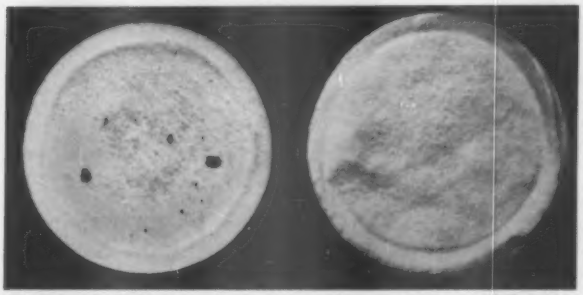

Unretouched photograph of actual filter test shows difference in purity and cleanliness between a leading granular, cube-like salt (left); and Diamond Crystal Flake Salt (right).

Notice how impurities in the granular salt used discolored the corn on the left—while pure Diamond Crystal has protected the golden appeal of the corn at right. Which brand do *you* think the housewife would buy again?

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BROZEK, J. AND GUETZKOW, H. (Univ. of Minnesota, Minneapolis). *Am. J. Clin. Nutrition 5*, 109–10 (1957).

The present study was concerned with the impact of a thiamine-free diet. In acute deprivation definite signs of deficiency developed in a matter of days or weeks. Oral administration of thiamine was started for each man when it appeared that the deficiency had progressed as far as we considered safe. At this time general weakness and incoordination of the legs was very pronounced, anorexin was extreme, and hyperpyruvinemin was present. Thiamine supplements restored appetite and brought about a dramatic change in the attitudes of the subjects. With other vitamins of the B-complex available in adequate amts., the intake of 0.2 mg. of thiamine per 1000 cal. in our subjects (healthy young men), was at the borderline of deficiency.

On the nutritive effect of methionine homologue.

TERAJIMA, I., YUICHI, K. AND HIRASHI, A. *Tohoku J. Agr. Research 5* (2), 153–8 (1954); *Biol. Abstr. 31*, No. 7307 (1957).

Whereas the S-contg. amino acid methionine is essential in the nutrition of animals, its homologue ethionine is toxic. The further homologues propionine and butionine, tested on rats, diminished the growth rate, but are less toxic than ethionine.

Abnormal glucose tolerance in experimental choline-deficient fatty liver.

WALDSTEIN, S. S., ETTINGER, R. H. AND GIGES, B. (Walter Reed Army Medical Center, Washington, D. C.). *Metabolism, Clin. and Exptl. 6*, 134–43 (1957).

Fatty liver was produced in dogs by the feeding of an artificial, high-fat, choline-deficient diet. The livers of these animals contained significantly greater amts. of both fat and glycogen than livers of animals fed a normal kennel diet. Dogs fed the same artificial diet supplemented with choline did not develop fatty liver. Both groups fed the artificial diet responded to glucose infusion by abnormally high glucose levels, but only the group with fatty liver showed impaired clearance of glucose when the infusion was stopped. Possible explanations for these findings have been discussed. Choline deficiency in the dog results in a fatty liver which resembles human fatty liver in many respects, including the development of abnormal glucose tolerance.

Effects of storage upon the nutritive value of barley grain as a source of protein.

KOCH, B. A. AND MEYER, J. H. (Univ. of California., Davis). *J. Nutrition 61*, 343–55 (1957).

Under the conditions of these studies the nutritive value of barley protein was not decreased when the grain was stored for as long as three years. The av. wt. gains and feed efficiency values obtained from feeding barley which had been stored for 3 years were equal to those obtained with new-crop barley when both barleys were supplemented with equal amts. of casein or equal amts. of a soybean-cottonseed meal mixt.

Metabolism of essential fatty acids. V. Metabolic pathway of linolenic acid.

STEINBERG, G., SLATON, W. H., HOWTON, D. R. AND MEAD, J. F. (Univ. of California, Los Angeles). *J. Biol. Chem. 224*, 841–9 (1957).

The polybromo fatty acids isolated from rats which had been fed Me linolenate-1-C^{14} were isolated, debrominated, and hydrogenated. Degradation by 1-carbon steps of the arachidic acid sepd. from the resulting satd. fatty acids revealed that its unsatd. precursor had been formed from linolenate by the addn. of acetate to the carboxyl end. Indirect evidence was obtained which indicated that linolenate is converted, not to arachidonic but to a different polyunsatd. acid, possibly eicosapentaenoic acid.

Factors influencing survival of rats in fasting. Metabolic rate and body weight loss.

RIXON, R. H. AND STEVENSON, J. A. F. (Univ. of Western Ontario, London, Canada). *Am. J. Physiol. 188*, 332–6 (1957).

The individual duration of survival of adult rats in complete fasting varied considerably; the range at an environmental temp. of 22° C. was 6–16 days, at 2–5° C., 1–7 days. The duration of survival in fasting has been correlated with the individual metabolic rate, whether measured before or during fasting. The previous diet whether high in protein, fat or carbohydrate had little effect on the duration of survival.

Psychologic factors regulating the feeding process.

YOUNG, P. T. (Univ. of Illinois, Urbana). *Am. J. Clin. Nutrition 5*, 154–61 (1957).

It is clear that we cannot rely too strongly upon the wisdom of the body as a guide to correct nutrition. This must be supplemented by the wisdom of the nutritionist based upon years of careful research. But even the wisdom of the nutritionist is insufficient if he fails to take account of the psychologic factors that regulate the feeding process. After the nutritionist has prepd. an adequate diet the animal may refuse to eat it, or he may eat excessive quantities and suffer therefrom. Hence the science and art of feeding animals and men must rest upon psychologic principles as solidly as it rests upon the principles of physiology, chemistry, and the science of nutrition.

Gastrointestinal regulation of water and its effect on food intake and rate of digestion.

LEPKOVSKY, S., LYMAN, R., FLEMING, D., NAGUMO, M. AND DIMICK, M. M. (Univ. of California, Berkeley). *Am. J. Physiol. 188*, 327–31 (1957).

An investigation was undertaken to det. the effects of H_2O deprivation during meals in rats. Withholding of H_2O during meals does not appear to interfere with digestion but it definitely decreases appetite and effects a reduction of food intake.

Studies on growth promotion by antibiotics. II. Results of Aurofac administration to infants.

OZAWA, E. (Sch. Med., Kyoto Univ., Japan). *J. Antibiotics* (Tokyo) *8*, 212–14 (1955); *Biol. Abstr. 31*, No. 4059 (1957).

Somewhat underweight infants given 0.5 to 3.0 g. Aurofac (26.8 mg. chlortetracycline and 4.2 μg. vitamin B_{12}/g.) daily for about 2 mos. started to gain wt. more rapidly starting 2 weeks after treatment was initiated; one infant whose wt. and condition were normal initially showed no effect from Aurofac. The wt. gain in treated infants appeared to be due to increased subcutaneous fat deposition. In non-breast fed infants, administration of Aurofac lowered the pH of the feces and decreased the numbers of *Escherichia coli* in the feces; this effect simulated the fecal condition found in breast-fed infants.

Pharmacology and Toxicology

Influence of gum tragacanth on the bactericidal activity of preservatives.

EISMAN, P. C., COOPER, J. AND JACONIA, D. (CIBA Pharmaceutical Products, Inc., Summit, N. J.). *J. Am. Pharm. Assoc.*, Sci. Ed., *46*, 144–7 (1957).

The presence of gum tragacanth exerts a strong neutralizing effect upon the bactericidal activity of chlorbutanol, the *p*-hydroxybenzoates, and the quaternary ammonium base, benzalkonium chloride. This neutralizing effect has also been observed, although to a much lesser extent, with phenol, phenylmercuric acetate, and merthiolate. These findings have important implications for the pharmaceutical industry in that preserved products containing gum tragacanth or other vegetable gums may become completely devoid of self-sterilizing properties soon after manuf. or upon storage.

Methemoglobinemia from eating meat with high nitrite content.

ORGERON, J. D., MARTIN, J. D., CARAWAY, C. T., MARTINE, R. AND HAUSER, G. H. (Louisiana State Department of Health). *Public Health Repts. 72*, 189–93 (1957).

From the outbreak that occurred near New Orleans, La. it was found that met-

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hemoglobinemia resulted from eating wieners and bologna contg. large amts. of nitrite. Nitrite poisoning is discussed.

Physiology and Medicine

Impairment of triglyceride absorption by the exclusion of pancreatic juice in the rat.

KARVINEN, E., LIN, T. M. AND IVY, A. C. (Univ. of Illinois, Chicago). *Am. J. Physiol. 188*, 61–5 (1957).

A fat balance study was conducted on rats. Fat utilization was correlated more closely with the m.p. of the fats than with their satn., suggesting that the m.p. is concerned in detg. utilization more than any other characteristic of the fat. The best utilization was attained with fats that are liquid at 20° C.

FOOD AND FOOD TECHNOLOGY

Fruit Juices

Volatile water-soluble and oil constituents of Valencia orange juice.

KIRCHNER, J. G. AND MILLER, J. M. (Western Utilization Research Branch, Agricultural Research Service, U.S.D.A., Pasadena, Calif.). *J. Agr. Food Chem. 5*, 283–91 (1957).

The nature of the chem. changes in the water and oil constituents of the volatile flavoring material of fresh, freshly canned, and stored canned California Valencia orange juice has been investigated. Acetic, propionic, isovaleric, and traces of butyric acid were found in the stored juice. There was a decreased acetaldehyde content and traces of diacetyl. A $C_6H_8O_2$ unsatd. acid previously found in grapefruit juice was present in all three orange juices. Twenty-nine compds. from the oil fraction were identified and their amts. detd. in each of the 3 juices. Analyses were made by chromatographic techniques when possible. The major changes in the oil fraction of orange juice on canning and storage were loss in total volatile oil, conversion of hydrocarbons to alcs., and loss in esters, aldehydes, and terpene aliphatic alcs. The predominant off-flavor of stored canned orange juices appears to arise from the non-volatile precursors.

Studies on the preservation of fresh apple juice with sorbic acid.

FERGUSON, W. E. AND POWRIE, W. D. (Dept. of Agr., Ottawa, Canada). *Appl. Microbiol. 5*, 41–3 (1957).

Sorbic acid in low concns. which cause no noticeable flavor changes will effectively prevent yeast fermentation in fresh, unpasteurized apple juice. However, control of the above-mentioned fungi created conditions favorable for the growth of AcOH bacterin which developed after approx. 4 days in nonfermenting juice in incompletely filled or loosely capped containers. The addn. of ascorbic acid, an antioxidant (in conjunction with the sorbic acid), inhibited the growth of these *Acetobacter* if air was excluded from the containers by complete filling and tight capping. Fresh, unpasteurized apple juice contg. 0.035% sorbic acid and approx. 50 mg. ascorbic acid per 100 ml. of juice may be preserved without refrigeration for a min. period of 2 weeks with little loss of flavor quality.

Milk and Milk Products

Structure of milk crumb.

SAUNDERS, J. (W. & M. Duncan Ltd., Beaverhall Road, Edinburgh, Scotland). *Chemistry & Industry* (1957) 52–3.

There is clear evidence of a reaction between chocolate liquor and milk, and sucrose and milk which involves a blocking of reducing groups or a prevention of the exposure of reducing groups on heating. No such reaction takes place between chocolate liquor and sucrose. It seems that the reactions between the ingredients in the manuf. of milk crumb involve a complex formation or combination between the milk solids and the chocolate liquor and the milk solids and the sucrose, involving groups which normally are available to reduce $K_3Fe(CN)_6$ and which in the latter case involves groups which become available for water sorption.

Pectin

The jelly strength grading of pectins for use in jam manufacture.

OLLIVER, M., WADE, P. AND DENT, K. P. (Chivers & Sons, Ltd., Histon, Cambridge, Engl.). *J. Sci. Food Agr. 8*, 188–96 (1957).

Gels prepd. from rapid-set powder pectins by the "acid-in-boil" procedure may vary in strength, as measured by the Ridgelimeter, according to the type of sugar used. This variability, not generally shown by slow-set powder or by liquid pectins, can be overcome by adding surface-active agents or fruit juices. A method for detn. of grade of pectins is proposed which gives results in line with those obtained by the "acid-in-glass" procedure. The reliability of the proposed method for jam manuf. control has been confirmed.

INDUSTRIAL HEALTH

Production of bacterial aerosols in a rendering plant process.

SPENDLOVE, J. C. (Dugway Proving Ground, Dugway, Utah). *Public Health Repts. 72*, 176–80 (1957).

The rendering process creates aerosols and the heaviest concn. of aerosols appears to be in the vicinity of the grinder and the gut hasher. Vegetative organisms persist in the grinder and gut hasher after these machines have been initially inoculated. Both vegetative and spore-forming organisms survive the blowing operation and are released into the atm. Both vegetative and spore-forming organisms can be recovered 100 ft. downwind from the exhaust stack. It is recommended that all animal material other than hides be heated prior to processing.

PACKAGING

Filling bottles—in the case.

Packaging Parade 25(4), 74+ (1957). Entire cases of bottles can be filled simultaneously in one pass through a new liquid filling machine. Machine can fill 300 cases (12's) per hour with five men operating the line.

PHYSICAL RESEARCH

The characterization of pressure-sensitive adhesives.

WETZEL, F. H. (Hercules Powder Co., Wilmington, Del.). *ASTM Bull.* 64–8, April 1957.

Quantitative methods for a study of factors affecting pressure-sensitive adhesion have been developed. (1) Tack is detd. as a surface property that defines the instantaneous adhesiveness of the tackifying resin-elastomer mass. (2) Yield stress of free films reflects the internal strength or cohesion. A study of viscosity affords a scale for comparison of long-term flow.

MISCELLANEOUS INFORMATION

Synthetic detergent symposium. (Presented at the 30th annual fall meeting of the American Oil Chemists' Society in Chicago)

J. Am. Oil Chemists' Soc. 34, 170–216 (1957).

Papers presented are: Synthetic detergents. Development and use in domestic washing products. Review of alkylaryl sulfonates. Fatty alcohol sulfates. The alkylolamides. Nonionic surfactants. Sugar esters. Ampholytic surface-active agents. Analytical test methods for organic detergents. Analytical test methods for the inorganic portion of the detergent products. Surfactant survey. Evaluation of surfactants for oil field flooding. Status of research related to the use and effect of surfactants on various crops and soils.

New use for bark.

Frontier 20(1), 2+ (1957).

A method has been developed for the conversion of bark into an inexpensive and effective soil builder. Production of the soil builder involves grinding the bark, condensing the tannin by addn. of formaldehyde, followed by acidification with HCl or H_2SO_4. Water and excess chems. are removed, and the material is washed and dried.

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INDUSTRY PUBLICATIONS

Exact Weight Scale Co., 944 W. Fifth Ave., Columbus, Ohio, is offering a new eight-page brochure describing and illustrating its **Shadograph Scales** for the food processing industry. The brochure, Form 3333, contains detailed specifications and important features of 34 models with capacities ranging from 2,000 mg. to 100 lb.

Soy Flour: Complement to Modern Eating, a booklet produced by Archer-Daniels-Midland Co., points out that, pound-for-pound, soy flour contains about twice as much protein as meat, four times as much as eggs, and twelve times as much as milk. The booklet, which emphasizes the value of soy flour in institutional feeding, can be obtained by writing the company at 700 Investors Bldg., Minneapolis 2.

A colorful, 16-page brochure has been produced by Portland Copper & Tank Works, Inc., 80 Second St., S. Portland, Maine, to outline its operations and services. The illustrated booklet reviews company history and operating methods, and describes **Portland Copper's** technical advances in the fabrication of stainless steel and high-temperature alloys.

An informative, four-page bulletin, No. 50AA, with details on the new **Trojan A Series** portable belt conveyor, has been published by E. W. Buschman Co., Clifton and Spring Grove Aves., Cincinnati 32. Complete operating and installation specifications are included.

Nominations for the sixth annual **Glycerine Research Awards** currently are being accepted by the awards committee of the Glycerine Producers' Assn., 295 Madison Ave., New York 17. The awards—of $1,000, $300 and $200—have been given annually since 1952 to recognize and encourage research leading to new and improved applications of glycerine or glycerine derivatives.. Originality in extending the use of glycerine to new fields, either consumer or industrial, receives special consideration. A bulletin giving details of the 1957 awards can be obtained from the association. Closing date for nominations is Nov. 1, 1957.

Salt qualities and how they are important in industrial applications are discussed in a new booklet produced by Diamond Crystal Salt Co., St. Clair, Mich. The booklet outlines salt characteristics, describes the four basic types of salt, and gives a simplified step-by-step explanation of Diamond Crystal's exclusive Alberger process.

Du Pont's Polychemicals Dept. has prepared a 24-page booklet devoted to the **Use of Tynex Nylon Bristles** in brushes for dairy work. Tynex, which can be made in any length and diameter desired, has been fashioned into dozens of special dairy brushes, all of which are illustrated and described. Copies of the booklet can be obtained from the Polychemicals Dept., E. I. du Pont de Nemours & Co., Wilmington 98, Del.

A new bulletin describing a major development in the process control field—**Dynamic Control Systems**—has just been published. In contrast to steady-state systems, dynamic control systems program and regulate one or a number of transient variables in a process. Although the main emphasis of the bulletin is on aeronautical testing, the principles involved are applicable to industrial processing generally. Copies of Bulletin G-102 are available from CDC Control Services, Inc., 400 S. Warminster Rd., Hatboro, Pa.

Published recently was a 450-page statistical volume, **Critical Data Tables,** described as "the most complete compilation to date of tables, charts, graphs and similar information pertaining to processes and products of the corn-refining industry." The book contains sections dealing with important physical properties of corn and related products; detailed statistical treatment of such factors as boiling and freezing points and refractive indices; and essential humidity and water tables, corrections and conversion tables. The volume stemmed from projects of the Technical Advisory Committee of the Corn Industries Research Foundation, which is handling distribution of the book from its office at 1001 Connecticut Ave., N.W., Washington 6, D. C. The price is $4.

An eight-page catalog of **Vosstex Belting** has just been issued by Voss Belting & Specialty Co., 5645 N. Ravenswood Ave., Chicago 26. Numerous types of special belting are described, and two pages are devoted to tables and formulas to aid in selecting proper belting types and weights.

A folder describing **Filter Fabric** made from napped spun Orlon is available from Filtration Fabrics Div., Filtration Engineers, Inc., 155 Oraton St., Newark 4, N. J. Called Feon 408, the fabric is recommended for use with either wet or dry filtration equipment. A sample is included.

E. I. du Pont de Nemours & Co., as part of a program to call public attention to the effects of current tax rates on individual and corporate incentive, has published **The Story of Taxes,** a 32-page booklet outlining the historical background of taxation and detailing some of the effects of present-day tax rates. Copies can be obtained from the company's public relations department, Wilmington 98, Del.

The complete line of **Fork-lift Trucks, Straddle Carriers, Powered Hand Trucks and Towing Tractors** produced by the Industrial Truck Div. of Clark Equip-

fmc Continuous Vertical Screw Press

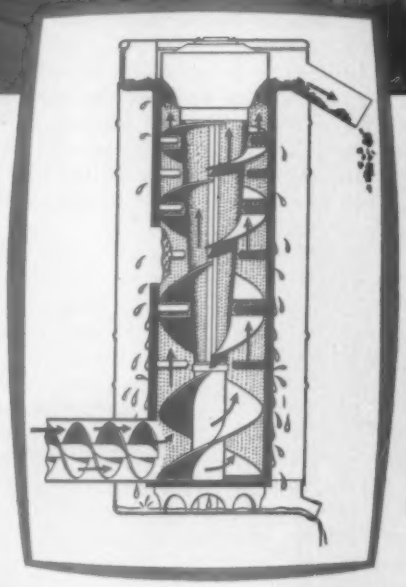
New "Counter-Flow" Design Produces Highest Fluid Recovery

Actual operating results prove conclusively that the FMC Vertical Screw Press greatly increases the overall efficiency of juice or fluid extracting operations. Its pressing action is gentle, resulting in an improved product quality even while obtaining higher fluid recovery. Reduced handling and disposal costs of low moisture content wastes provide even further savings.

In operation, press cake is quickly and easily formed at start-up; "channeling" is eliminated, preventing loss of unpressed material; flow of fluid is downward — doesn't re-wet the dry pomace. And this press is easy to clean. The outer screen frame is opened on hinges, and the center spindle and components are reached by releasing a single quick-opening clamp.

Full information is available on request. Just write, or call your nearest FMC representative.

Vertical Screw Press in a tomato line at the Oakland plant of F. M. Ball & Co., Div. of Hawaiian Pineapple Co. Installation was made and *paid for itself in one season!* These units permit more flexible use of pulpers and finishers on tomato products, resulting in reduced screen wear. Gentle pressing action of moist pomace means high product quality — even while greatly increasing recovery.



Drawing illustrates FMC "Counter-Flow" design, shows pressure feeding of material at bottom of machine, upward travel and discharge of pressed solids at the top.

fmc Key To good equipment

FOOD MACHINERY AND CHEMICAL CORPORATION

Canning Machinery Division

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ment Co. is described in a 16-page, four-color catalog just published. Copies are available by writing the company at Battle Creek, Mich.

Guenther Reports, written by Dr. Ernest Guenther, vice-president and technical director of Fritzsche Bros., Inc., during his current tour of Africa and Madagascar, are being published periodically by the company. Dr. Guenther's remarks cover details of the tour as well as side comments on the spice and essential oil industries he is studying en route. Copies of the reports can be obtained from the company at 76 Ninth Ave., New York 11.

Preliminary results of a **Study of Sugar Penetration** into canned cling peaches have been released by the University of California Department of Food Technology. The project, conducted by the department through a grant-in-aid from the American Maize products Co., investigated the penetration using starch hydrolysis products of the amylose series labeled with carbon-14. Small amounts of the C-14 labeled sugars, ranging in size from glucose to malto-hexose, were added to a normal cover syrup in which peaches were canned. Normal canning procedures were followed, and the penetration of the sugar into the peaches was studied by histological and radio-chemical techniques.

The study was designed to determine whether the equilibrium in cutout brix of cover syrup is osmophilic equilibrium or density equilibrium. According to the report, the results seemed to prove that the various sugars travel indiscriminately into the peach and appear within the cells as well as between the cells. However, the rate of diffusion is inversely related to the number of glucose units in each molecule of the various sugars.

The researchers felt that although the magnitude was not as great as was expected, a slight preference still is indicated, all other things being equal, for the syrups containing a larger proportion of the high polymers.

Industry

PRODUCTS

New Fruit Flavors. A new group of flavoring materials is being introduced to manufacturers of bottling and fountain syrups, ice cream, sherbets and cordials. Classified as fruit flavors "with other natural flavors," the materials are described as being made from the finest natural fruit extractives, concentrated to optimum strength for maximum flavor quality; they contain less than 50% of added flavor fortification from other selected fruits, essential oils and various botanical tinctures.

Known as W.O.N.F. flavors, the new products are said to offer certain advantages over ordinary imitation flavors: they impart a more natural taste and aroma, standardized strength of flavor, color and acidity make them easier to use, concentration reduces storage costs, and they are less costly than corresponding natural juices.

Currently offered is a selection of nine flavors: apricot, blackberry, black raspberry, cherry, grape, peach, pineapple, strawberry and wild cherry. Trial samples may be obtained from Fritzsche Bros., Inc., 76 Ninth Ave., New York 11.

Seasoned Seafood Tenderizer. Dodge & Olcott, Inc., recently introduced a seasoned tenderizer for seafoods, designed for use prior to quick-freezing or cooking. Called Spisorama (Liquid) Seasoned Seafood Tenderizer, the product is a blend of spice essential oils and tenderizing solution with a small proportion of sodium benzoate added.

In use, seafoods are completely immersed in the solution for 30 seconds, then frozen or cooked immediately to stop the tenderizing action and prevent excessive tissue breakdown. The new product is available in two forms, seasoned and unseasoned, and trial quantities can be obtained from Dodge & Olcott, Inc., 180 Varick St., New York 14.

Joint Filler for Tile. Maintenance engineers are being introduced to a new resinous joint filler for quarry tile floors, said to be virtually as permanent as the tile itself. Called Poly-Rock E, the compound is reported to be impervious to all known food acids, as well as hot and cold water, cleaning solutions, etc. According to the manufacturer, adhesion and breakage tests have shown that the tile will break before the joint filler cracks loose.

Poly-Rock E is said to be less porous than tile; it also is nonshrinking, so hairline cracks cannot develop between the tile and the filler. The product is available in small packages for repairs, as well as in larger packages for new construction. More details can be obtained from Plant Maintenance, Inc., 623 Green Rd., Cleveland 21.

Detergent for Steam Cleaning. Oakite LSD, a liquid detergent for use in solution-lifting steam guns and self-generating steam cleaning equipment, was introduced recently by Oakite Products, Inc. Developed to simplify the preparation of steam cleaning solutions and to reduce clogging of coils in self-generating equipment, the product is designed to handle a variety of steam cleaning operations ranging from light to medium-heavy duty.

Oakite LSD is said to provide effective soil removal at concentrations of 1 to 2 ounces to each gallon of water as delivered by the gun. Used as recommended, it is claimed to be safe on steel, brass and magnesium, and to have no effect on painted surfaces. Its solu-

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tions have a pH of 12 in the operating range. Further information is available from Oakite Products, Inc., 19 Rector St., New York 6.

Plastic Packaging Advance. Housewives soon will be able to inspect frozen food purchases in clear plastic containers, place the food in oven or broiler in the same containers, and cook the food without fear of having the plastic scorch or melt. Du Pont's Mylar is the plastic that will make this possible. Mylar is not new, but until recently no cheap, fast process was available for forming it into food containers.

Now, however, Auto-Vac Co., Bridgeport, Conn., has announced development of the Pressure-Vac machine, which forms Mylar rapidly into strong, light, transparent containers by use of a combination of heat, pressure and vacuum. The process is said to be so simple and well developed that one processor already is conducting tests with a view to early marketing.

Pressure-Sensitive Sealing Tape. A new form of Teflon has been added to the line of Teflon products handled by the Chicago Gasket Co., 1271 W. North Ave., Chicago 22. It is a pressure-sensitive adhesive tape that can be attached to most surfaces, including metal, glass and plastic. The company says that the special silicone adhesive will provide a firm bond, with high peel strength, at temperatures up to 500° F. Available in widths up to 2-in., the tape is supplied in 36-yd. rolls of 0.006-in. thickness and 18-yd. rolls of 0.013-in. thickness. Both types also can be supplied in 12-in. sheets.

Low-Cost Wall Finish. Improved sanitation on walls and ceilings at $\frac{1}{15}$ the cost of tile is possible with a new product called Sanitile, according to the Master Mechanics Co., Cleveland 13. Applied over wood, plaster, wallboard cement or concrete block, Sanitile reportedly creates a one-piece, ceramic-like surface that resists the action of steam, condensation, water, grease, acids and alkalis. Its hard, high-gloss surface is said to prevent the growth of mold, bacteria and fungi. Sanitile is being used in many food processing plants to meet state and federal sanitary regulations.

EQUIPMENT

Plastic Lab Beaker. Designed for a variety of uses in the laboratory, the new plastic Standfast beaker recently was introduced by Standfast Products Co., 2146 Murray Hill Rd., Cleveland 6. The beaker, made of white, top-quality polyethylene, has a half-gallon capacity and is said to be resistant to solvents, alkalis and common acids; it may be washed safely in very hot water. The manufacturer says that the seamless body of the beaker is truly unbreakable and will not crack or chip. The beaker also is available with a tight-seal lid and cap, integrally molded, that converts it into a pitcher.

Small Particle Measurements. An instrument originally developed for medical-biological work is finding wide use in measuring small particles in industrial applications. Called the Coulter Counter, Model A, it operates on a new principle involving the forced passage of a fluid suspension of particles through a small aperture having an electrode on either side. As a particle passes through, the aperture resistance changes in proportion to the particle size; the resulting series of electrical impulses is scaled and counted electronically, and curves of cumulative particle frequency vs. particle size are obtained directly. Apertures from 35 to 400 microns count particles ranging from 0.7 to 200 microns, and a range of 20 to 1 in particle size is readily obtained with a single aperture.

The new method is said to be inherently more accurate than visual microscope counts, because the fatigue element is virtually eliminated and large counts (10,000 to 100,000) reduce statistical error. A ten-point particle content and size distribution determination requires 5 to 10 minutes, and technician time is said to be reduced by 90-95%.

Full details are available from Coulter Industrial Sales Co., Box 22, Elmhurst, Ill.

Automatic Test Control. A compact device called the Programmer Counter has been developed to control test apparatus in which the limits are sensed by strain gauges, thermocouples or any other transducers that have a maximum output not exceeding 100 mv. D.C. The unit is said to simplify the setting

up of equipment each time a test is made, and to eliminate the need for manual control of test cycling. The two adjustable, stable thresholds of the Programmer Counter provide precise selection of upper and lower operating limits; a counter, which may be of the preset type, registers each cycle. For complete details, write Spar Engineering & Development, Inc., Wyncote, Pa.

Ultrasonic Emulsifiers. Recently introduced into this country from England is a line of emulsifiers that operate on a new ultrasonic principle. The machines — called the Rapisonic, Autosonic, Dispersonic and Minisonic—use the fluid-

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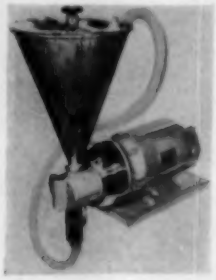
dynamic forces of the liquids themselves to produce the sound waves, instead of generating the ultrasonic energy outside the liquids. This is done by impinging the liquids to be emulsified in a jet

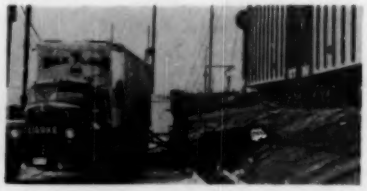


stream on the edge of a blade. The blade vibrates at its natural frequency, about 22,000 cps, and cavitation occurs continuously in the stream rushing past the blade. All energy is developed and used right in the liquids.

The Rapisonic is a production model, with a capacity of up to 350 gal. per hour, designed to handle emulsions of high and low viscosity. Its companion, the Autosonic, is intended for continuous-process service. The Dispersonic, as its name implies, is designed to handle dispersions of powders in liquids or emulsions of an abrasive nature. And the Minisonic (pictured) is a batch-type machine for laboratory or pilot plant use. Complete information on all three machines, and their application to food industry problems, can be obtained from Sonic Engineering Corp., 146 Selleck St., Stamford, Conn.

Sanitary Flowmeter. A flowmeter designed to meet the most rigorous sanitary regulations has been introduced for measuring milk, fruit juices, beverages, liquid sugar and other liquid foods. Made of stainless steel or a variety of corrosion-resistant alloys, the meter can be obtained with flanged and threaded pipe couplings or with tri-clover quick-disconnect coupling, to facilitate removal from the line when frequent cleaning is necessary. The entire assembly—one moving part and four static parts—can be taken apart without tools. The meter can be placed in the line in any position and is said to perform with a high degree of accuracy and linearity over a wide flow range. Operating details and specifications can be obtained from Potter Aeronautical Corp., Industrial Div., Union, N. J.

Steam-Generator Warranty. Clayton Mfg. Co., El Monte, Calif., announced recently that it is offering a five-year warranty, including labor costs, on Clayton steam-generator coils. The guarantee covers replacement of any coil within the first year without cost; thereafter, replacement cost is on a pro rata basis.



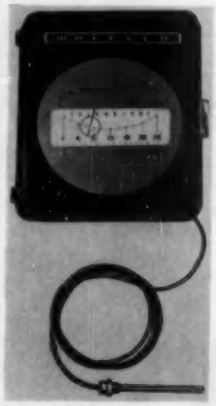
Mechanized handling of bulk flour is being utilized by Clarke Bulk Transfer to deliver 50 carloads per week to bakeries in the Philadelphia area. Here flour from Airslide car is being unloaded by Airslide fluidizing conveyor (on rails in center) and transferred to special trailer van at rate of 35,000 lbs. per hour. Upon arrival at bakery, hoses from van are connected to bakery's pneumatic lines; van carries its own blowers and control equipment to deliver flour into bakery's storage bins. Van can unload and deliver contents of railroad car—about 100,000 lbs.—in three trips.

Pneumatic Instrument Safeguard. A new device has been introduced to detect unfavorable moisture build-up in the air lines of pneumatically operated instruments. Called the dew-point monitor system, it consists of two components: the Aminco Humistat, a humidity controller containing a sensitive electronic switch that actuates an alarm when a pre-set dew-point temperature is exceeded, and a small electric hygrometer sensing element that relays changes in moisture content to the Humistat.

The sensing element is installed directly in the pressure system with a threaded coupling. The Humistat may be set to actuate an alarm for dew-point temperatures as low as —45° F. at 50 p.s.i. and —60° F. at 150 p.s.i. It may be used safely in pressure systems up to 1,000 p.s.i.

Additional information is in Bulletin 2273, available from the American Instrument Co., 8030 Georgia Ave., Silver Spring, Md.

New Thermometer Series. Included in a new thermometer series just introduced by Wheelco Instrument Div. are recorders, recorder-controllers, indicators and indicator-controllers. The Wheelco 4000 Series recorders and recorder-controllers use 12-in. charts and are said to represent the most advanced design in electronic instruments. Uniform accuracy over the entire scale is assured through the use of mercury-actuated sensing elements. Wheelco says its Thermotrol temperature indicators and indicator-controllers incorporate all of the features of the 4000 series.



Both recorder-controllers and indicator-controllers are available in eight control forms for various types of service; the temperature range of the new series is from

Safeguard Food against Mold and Yeast Spoilage with SORBISTAT®

Here's a promise of new protection for a wide variety of food products. Extensive tests have proved that Pfizer SORBISTAT (sorbic acid) selectively inhibits the growth of many molds, yeasts and certain bacteria which cause spoilage.

Cheese and cheese products, prepared gelatin, fruit, vegetable, and other salads, and fruit cake are some of the foods for which sorbic acid protection has been evaluated and found effective. The protective value of sorbic acid in pickles, soft drinks, pie fillings, and chocolate syrup is now being carefully analyzed. Reports indicate that in certain cases, sorbic acid is several times as effective as other antimycotic agents now in use.

Most important, since SORBISTAT is a selective growth inhibitor of yeasts and molds, it does not interfere with the normal microbiological curing of cheeses. At normally effective use levels SORBISTAT does not affect the appearance, taste or odor of any food product. It is a stable, easily stored, white crystalline powder that's added to foods as a powder or as an easily prepared solution.

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Mixing-Horsepower Computer. A new dynamometer accessory for the ELB experimental agitator now permits direct determination of horsepower required for mixing non-Newtonian fluids and gas-liquids. Previously, horsepower requirements for these classes of fluids could only be estimated. The

accessory consists of a tripod stand with adjustable leveling feet, a ball thrust bearing mounting for the ELB mixer, and a moment arm assembly that pivots from a bracket fastened to one leg of the stand. Motor torque is transmitted through the arm to the pan of a laboratory scale, where the amount of force is displayed in pounds. Horsepower can be determined accurately and simply by substituting the derived values in the standard horsepower formula.

Illustrated technical data may be obtained from Chemineer, Inc., 1044 E. First St., Dayton 2, Ohio.

Ring Balance Meter. Hagan Chemicals & Controls, Inc., is offering a redesigned model of its ring balance meter, used for recording, indicating and controlling process variables involving differential heads, flow, absolute pressures, specific gravity, etc. The actuating element of the meter is a hollow ring fitted with a baffle in the top and partly filled with a heavy fluid. Differential pressures, admitted through flexible S tubes to the ring on opposite sides of the baffle, give the ring a tendency to rotate around its axis and actuate the pen mechanism. Instrument accuracy is ±0.5% of full-scale range down to 10% of scale. Any meter can be used, without major changes, for measuring the differential of any type of fluid within range of the ring assembly.

Pneumatic and electrical transmitters can be added to all types of ring balance meters for remote service in recording, indicating or integrating, or for actuating elements of automatic control systems. Dual instruments contain two rings in a single case for simultaneous measurements.

Complete information on the ring balance meters can be obtained from Hagan Chemicals & Controls, Inc., 323 Fourth Ave., Pittsburgh, 30.

PERSONNEL

Dr. George F. Stewart, chairman of the department of poultry husbandry on the Davis campus of the University of California, sailed June 18 from San Francisco on a year's sabbatical leave.

Most of his leave of absence will be spent near Sydney, Australia, working with the Division of Food Preservation, Commonwealth Scientific and Industrial Research Organization. He plans to investigate egg spoilage and other egg problems under terms of a Fulbright scholarship. In addition to visiting various states in Australia, Stewart will spend some time in New Zealand, the Philippines, and Japan.

Stewart's wife and two daughters will go with him on the trip. During his absence, Dr. W. O. Wilson will be acting chairman of the department.

Dr. William Hampton, Chief, Fish Processing Section, Fisheries Division, Food and Agriculture Organization (FAO), Rome, the man who originated the idea of fish sticks, has been appointed Fish-

eries Technologist of the FAO Fisheries Mission to Chile.

The Mission, which will be headed by Mr. J. P. d'Alarcao, FAO Fisheries Economist, will investigate the actual and potential role of the fishing industry in the economy of Chile. It will attempt to identify factors limiting production and marketing and prepare a draft national plan for fisheries development.

Dr. Hampton joined the Mission in Chile immediately after attending the annual meeting of the Institute of Food Technologists in Pittsburgh, Pennsylvania in May.

Dr. Hampton, who was born in St. John's, Newfoundland, was for some years Director of Research and Development, General Foods Corporation (Seafoods Division), Boston. Before joining FAO he was Manager of the Bird's Eye Fisheries Laboratories of the Corporation. He originated the idea of fish sticks while with the GFC.

General Matthew B. Ridgway, Chairman, Board of Trustees, Mellon Institute, has announced the appointment of DR. THOMAS HARRISON DAVIES as a Director of Research in that institution. Dr. Davies, administrative head of the Multiple Fellowship sustained in Institute since 1952 by the Pittsburgh Plate Glass Company, has had a distinguished career in scientific research and its management. Born in Baltimore, Md., February 21, 1912, he was educated at The Johns Hopkins University where he received his A.B. in 1935 and his Ph.D. in 1938.

Prior to joining Mellon Institute Dr. Davies was an associate professor in the Institute for Nuclear Studies, in the Department of Chemistry, and in the Institute of Radiobiology and Biophysics (acting director, 1951-1952) of the University of Chicago. Previously Dr. Davies was an associate section chief of the Clinton Laboratories at Oak Ridge, Tenn., 1943-1946; research chemist, Lederle Laboratories, Pearl River, N. Y., 1940-1943; and a National Research Council fellow in medicine, California Institute of Technology, 1938-1940. His earlier research in-

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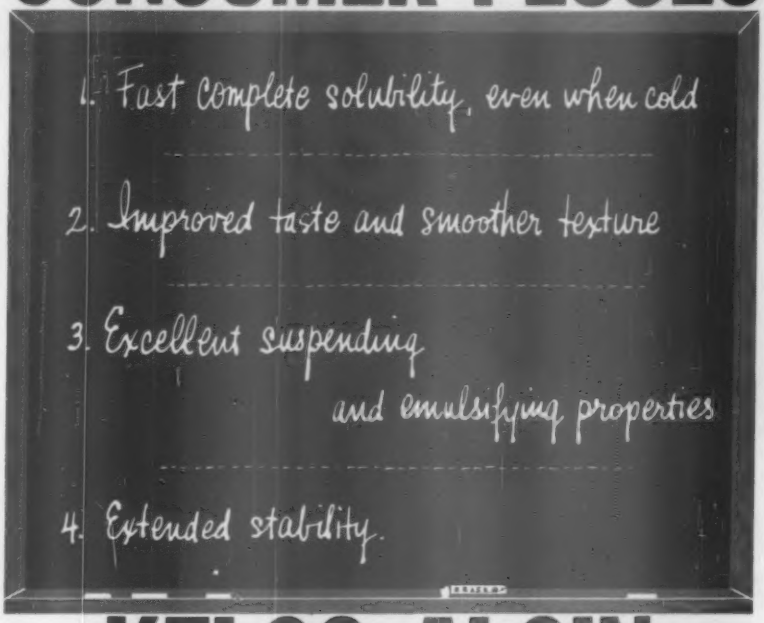
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terests have embraced the chemistry of the blood pigments, including oxidation-reduction processes and magnetic properties; immune bodies; uranium fission products; methods for separating plutonium; and chemical effects during radioactive decay. In his work at Mellon Institute Dr. Davies has developed a rigorously scientific research program on problems of structure, surface chemistry, and the solid-state physics of glass.

Dr. Edward F. Kohman, consultant to the Campbell Soup Co. and a member of IFT's Philadelphia section, recently was awarded a citation for distinguished service by the University of Kansas and its alumni association. Kansas gives

Edward F. Kohman

the citations in lieu of honorary degrees, which it does not award. Dr. Kohman was cited for his "conspicuous contributions in food technology and nutrition." A Kansas graduate in 1912, Dr. Kohman served with Yale University, the University of Illinois, the U. S. Department of Agriculture and the National Canners Assn. before joining Campbell in 1937. During the past two years he has spent much of his time as a food consultant in Italy and Austria.

Professor Frank A. Lee of the New York State Agricultural Experiment Station, Cornell University at Geneva, presented two papers at the Symposium on the Maturation and Germination of Peas, held at the University of Cambridge, Cambridge, England, on

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June 20 and 21. The Symposium was under the auspices of the Low Temperature Research Station of the University. The titles of the papers follow:

1. Determination of the Maturity of Green Peas.
2. The Lipid Fraction of Peas and Its Influence on the Development of Off-Flavor During Storage.

Dr. Lee visited laboratories in Scotland and England, and on the Continent. In addition, he attended the International Congress of Pure and Applied Chemistry, held in Paris, France, July 18 to 24. He was granted a Traveling Fellowship of the College of Agriculture of Cornell University to attend these meetings.

Howard F. Harris

Howard F. Harris has been appointed to the newly-created position of director of public relations for Corn Products Refining Co. He formerly was public information director for Grocery Manufacturers of America, Inc.

William J. Scarlett, food industry sales manager of the Industrial Division of Minneapolis-Honeywell Regulator Co. and a member of IFT, spoke recently before the 74th annual meeting of the National Confectioners Assn. in Chicago. Mr. Scarlett's topic was automation, and he told confectioners of some of the time and money savings possible through the use of automatic process control.

Merril A. Grogel

Merril A. Grogel has been appointed to the newly-created position of product supervisor for rigid foil containers at Reynolds Metals Co., Louisville, Ky. Mr. Grogel, with more than 25 years in the packaging field, formerly was vice-president and general manager of Cochran Continental Container Co., Louisville.

Richard M. Lawrence has been named research project analyst of the A. E. Staley Mfg. Co., Decatur, Ill. Mr. Lawrence formerly was director of business research for Wyandotte Chemicals Co., Dearborn, Mich.

Archer G. Wilcox has been named a research bio-engineer by Dairyland Food Laboratories, Inc., Waukesha, Wis. In addition to basic research and development, he will aid in an expanded program of technical services to the dairy and food industries.

Dr. Wolfgang Huber has become a member of the board of associates of Radiation Applications, Inc., New York City. Dr. Huber, an IFT member and a specialist in the radiation treatment of materials, will serve as West Coast representative for the company, working from offices in San Francisco.

R. A. Zuercher is the new sales and development engineer for the foil kraft division of Kaiser Aluminum & Chemical Sales, Inc., Chicago.

Carroll W. Harding, Jr., recently joined the staff of S. B. Penick & Co., 50 Church St., New York 8, as a specialist in the sanitizing products department. He previously was with Economics Laboratory, Inc., and Oakite Products, Inc.

Max H. Thornton

Dr. Max H. Thornton has been promoted to the new position of vice-president and technical director of Midwest Research Institute, Kansas City, Mo. Dr. Thornton, an IFT member, previously was technical director of the institute. He will continue to guide research work and supervise the technical staff.

Irving W. Reynolds, vice-president of the Foxboro Co., Foxboro, Mass., died June 3 at the age of 77. One of the first to join the indus-

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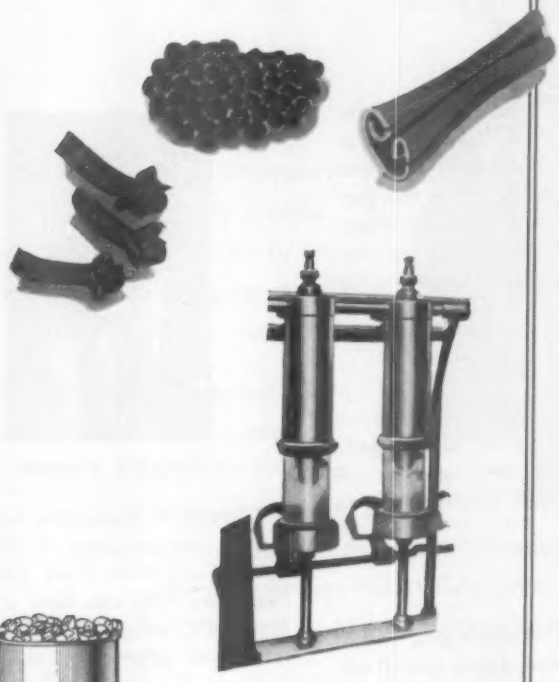

Our control starts with laboratory evaluation of a sample of the spice under consideration. It must *measure up* to Griffith's standard in both chemical and organoleptic evaluations.

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trial instrument firm, Mr. Reynolds had been with Foxboro since 1908, the year it was founded. He specialized in the production of precision instruments and, as factory manager, perfected special manufacturing techniques used by Foxboro.

Walter J. Meditz has been named vice-president in charge of manufacturing for Standard Packaging Corp. He has been with Standard since 1955 and formerly was assistant to the company president.

Russell M. Boshell has joined the San Juan Fish & Packing Co. as food technologist and technical marketing assistant. For the past two years he had been at Oregon State College, where he was conducting a marketing study for the U. S. Fish & Wildlife Service.

Frank A. Murdock was appointed recently by Ungerer & Co., Inc., New York, to direct sales on the West Coast from headquarters in Los Angeles.

A. L. van Ameringen, board chairman of van Ameringen-Haebler, Inc., New York City, manufacturers of flavors and fragrances, celebrated a double anniversary recently—his 40th year in this country, and his 40th year in the American flavor industry. A native of The Netherlands, Mr. van Ameringen organized his own company after a brief period as U. S. representative of a European perfume manufacturer.

A. L. van Ameringen

C. R. Calkins has been named to the new position of director of research and development for Riegel Paper Corp., New York City. He has been with Riegel since 1947 and had been director of research since 1955.

Edward E. Langenau

Edward E. Langenau has been elected vice-president of Fritzsche Bros., Inc., New York City. Mr. Langenau, who has been with the firm for 21 years, is director of the analytical laboratory and secretary of the company's research committee.

Dr. Roy E. Morse, Professor of Food Technology at Rutgers University, has been appointed Chairman of the Committee on Animal Products of the Advisory Board on Quartermaster Research and Development. The Advisory Board is appointed by the National Research Council of the National Academy of Sciences. As Chairman of the Animal Products Committee, Dr. Morse also becomes a member of the over-all Committee on Foods of the Advisory Board

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on Quartermaster Research and Development. Dr. Morse is well known in the animal products field having previously been Research Director for Kingan and Company, and William J. Stange Company, where he played a prominent part in the development of electrostatic smoking, animal fat rendering, and stabilization and general meats handling and processing.

Gardner Barker, formerly vice-president in charge of new products and acquistions for Thomas J. Lipton Co., New York City, has been appointed executive vice-president of the company.

Joseph D. Keating has been named assistant sales manager of Adolph's Industrial Food Products Co., Burbank, Calif. He formerly was with Huron Milling Co. for 18 years.

John B. Bowman, vice-president in charge of sales for Ekco-Alcoa Containers, Inc., Wheeling, Ill., was elected a director of the company at the annual meeting of the firm's shareholders.

William A. Rosenthal has been appointed manager of the newly-created vegetable oil products department of Topco Associates, Inc., Chicago, distributors of private-label grocery and frozen food products.

Stark Brokerage Co., Memphis, has been named broker in Tennessee, Arkansas and Mississippi for the line of spices produced by Knickerbocker Mills Co., New York City.

IN MEMORIAM

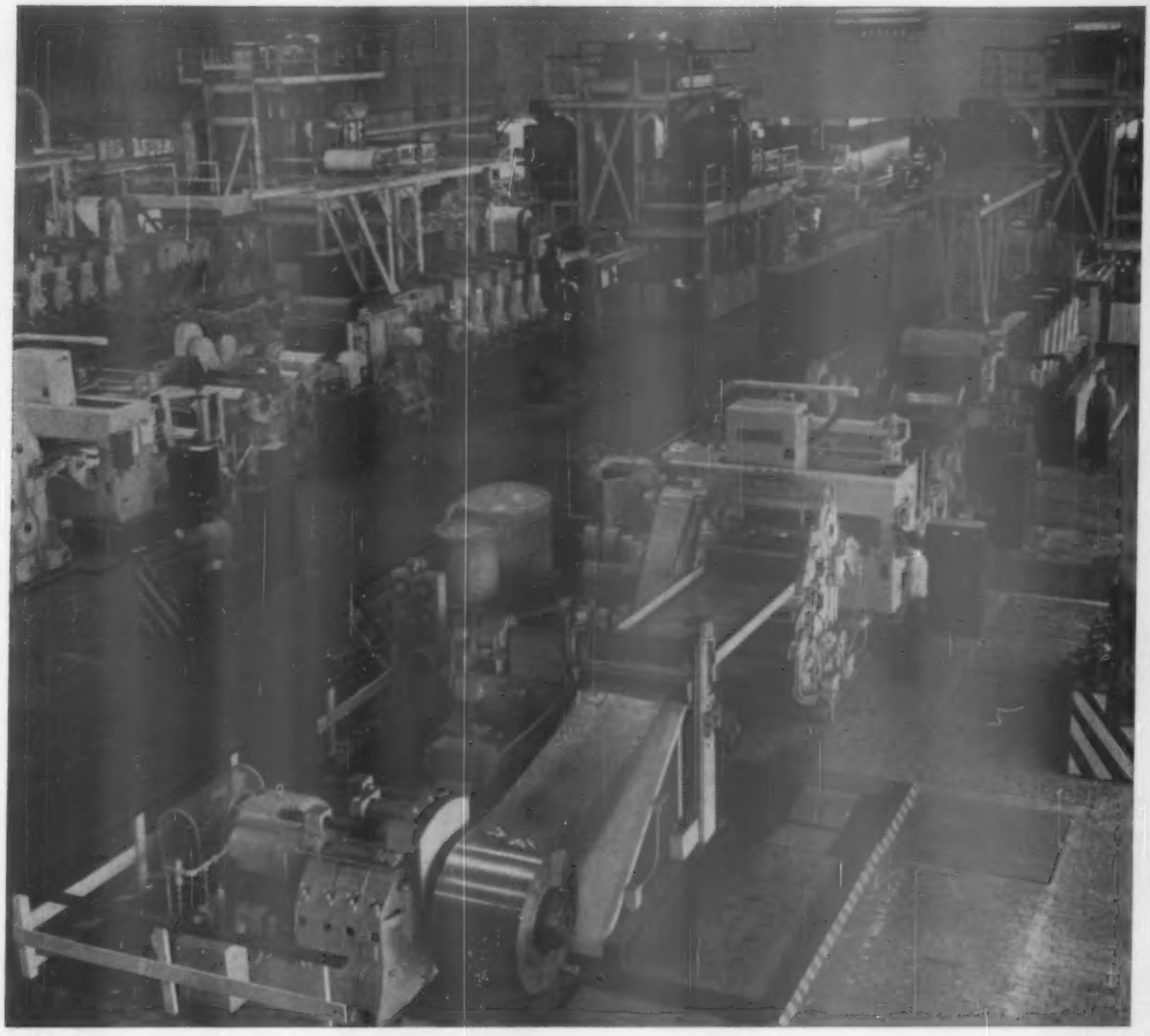
The death of Dr. Murray Philip Horwood, Professor of Sanitary Science and Director of Sanitation, occurred in Providence, Rhode Island, on June 4. He was 64 years old.

A native of New York, Professor Horwood was a graduate of the College of the City of New York. He received the M.S. degree from M.I.T. in 1916 and in that year joined the staff as an assistant in biology. In 1921 he was awarded a Ph.D., specializing in bacteriology, sanitation, public health and sanitary engineering. While on the staff of M.I.T. he had also been an instructor at Wellesley College and had been in charge of public health at Boston University Medical School and Tufts Medical School. He became Professor of Bacteriology and Municipal Sanitation in 1937 and Professor of Sanitary Science in 1944.

Professor Horwood was widely active as a consultant to municipalities and companies on problems of public health and sanitation and was the author of several books and more than seventy papers in those fields. From 1952 to 1954, he was Director of the M.I.T. Educational Project at the Engineering College of the University of Rangoon and conducted several health studies in Burma. At the time that he was fatally stricken he was engaged in a health survey in Bristol, R. I.

Surviving Professor Horwood are his wife, Mrs. Louise van Valkenburgh Peirce Horwood, whom he married when she was a biology student at M.I.T.; three children, Sargent Peirce Horwood, a student in Western Reserve Medical School, Mrs. Charles Seymour Alden of Belmont and Miss Charlotte Peirce Horwood of Washington, and two grandchildren.

—JAMES R. KILLIAN, JR.
President, Massachusetts Institute of Technology



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Joan Yen
302 Bryant Ave.
Ithaca, N. Y.

STUDENT

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Edward B. Lundquist
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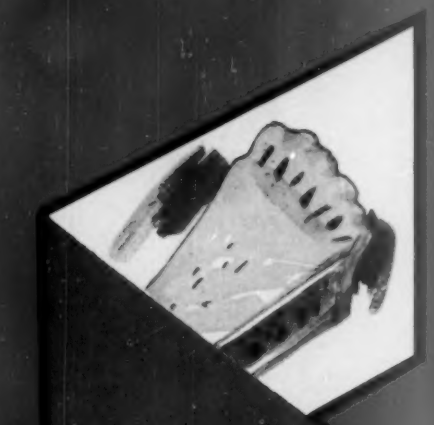

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